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THE 80th ANNUAL MEETING OF THE ASSOCIATION OF SOUTHEASTERN BIOLOGISTS

THE UNIVERSITY OF MEMPHIS, MEMPHIS, TN
THE UNIVERSITY OF TENNESSEE, MARTIN, TN

APRIL 3-6, 2019

MEETING SITE: MEMPHIS COOK CONVENTION CENTER AT THE SHERATON MEMPHIS DOWNTOWN HOTEL
MEMPHIS, TENNESSEE

Ellington Hall which houses the Department of Biological Sciences on the campus of The University of Memphis, Memphis, Tennessee.

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SOUTHEASTERN BIOLOGY

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PURPOSE

The purpose of this association shall be to promote the advancement of biology as a science by encouraging research, the imparting of knowledge, the application of knowledge to the solution of biological problems, and the preservation of biological resources. The ASB has representation in Section G Committee of the AAAS. Varying types of membership are available to individuals and institutions. See inside back cover.

TIME AND PLACE OF FUTURE MEETINGS

2019 April 3-6: Featured Institutions – The University of Memphis, Memphis, TN, and The University of Tennessee, Martin, TN. Meeting site is the Memphis Cook Convention Center at the Sheraton Memphis Downtown Hotel, Memphis, TN.

THE VIEW FROM HERE

A MESSAGE FROM THE PRESIDENT
J. CHRISTOPHER HAVRAN, ASB PRESIDENT 2019-2021

I was both excited and humbled to embark on a two-year presidency of the Association of Southeastern Biologists at the 2019 annual meeting in Memphis, Tennessee. My journey to this position actually began in Memphis fifteen years earlier. I gave my first presentation at a scientific meeting at the 2004 meeting of the ASB in Memphis when I was a graduate student at the University of Louisiana at Monroe. I remember loading up in a van and driving through Arkansas on our way to the conference, collecting quillworts and owl pellets on our return. The ASB meeting was a welcoming venue for me to present my Master's research. I've come to learn that the meeting is the first conference for many other biologists in the southeastern United States. I'm honored to count myself among the ranks of this multitude.

The 2019 meeting marked a return to the western boundary of our traditional meeting range. The Executive Committee is continuing to schedule meetings across the entire southeast to best meet the needs of our members. The 2020 and 2021 meetings have already been scheduled in Jacksonville, Florida, and Chattanooga, Tennessee. The 2020 meeting will be our first in Florida in over 25 years! As president-elect, I recently worked closely with the Executive Committee to plan beyond these years for future meetings. This past fall I was excited to travel to Little Rock, Arkansas, and Winston-Salem, North Carolina, to vet them as future locations for ASB meetings. Both cities offer exciting venues, vibrant downtowns, and have a lot to offer the ASB membership. I'm happy to say ASB will be visiting Little Rock in 2022 and Winston-Salem in 2023. The 2022 meeting will be the first time the ASB has ever met in Arkansas and 2023 will represent our first return to Winston-Salem since 1962.

The ASB is a volunteer-run association. Each year we require new members to rotate into committee positions or run for elected office to help manage different aspects our association. If you are a regular or first-time attendee of an ASB meeting and you would like to help the association, please consider volunteering. You can reach out to us about volunteering on our website.

I look forward to seeing you all next spring in Jacksonville, Florida!

Chris Havran

ASB Prestigious Awards Presented at the 2019 Annual Meeting in Memphis, Tennessee

Hosted by

The University of Memphis, Memphis, Tennessee
The University of Tennessee, Martin, Tennessee

ASB SUPPORT AWARDS

The Lafayette Frederick Underrepresented Minorities Scholar-ship ($1200)

- **2019 - Tania Perez,** Miami Dade College, Miami, FL

Support Award for Graduate Student Members of ASB ($250 plus ASB Banquet ticket)

- **2019**

Courtney Alley, University of Tennessee at Chattanooga, Chattanooga, TN
Sara Carter, University of Memphis, Memphis, TN
Claire Ciafre, Austin Peay State University, Clarksville, TN
Logan Clark, Appalachian State University, Boone, NC
William Commins, Kennesaw State University, Kennesaw, GA
Mary Feely, University of Tennessee at Chattanooga, Chattanooga, TN
Miranda Gulsby, Kennesaw State University, Kennesaw, GA
Amanda Hall, Columbus State University, Columbus, GA
Morgan Hussey, James Madison University, Harrisonburg, VA
Victoria Mendiola, Kennesaw State University, Kennesaw, GA
Thomas Murphy, Austin Peay State University, Clarksville, TN
Devin Preston, University of New Orleans, New Orleans, LA
Marietta Day Shattleroe, Appalachian State University, Boone, NC
John Shelton, University of Tennessee at Chattanooga, Chattanooga, TN
Elvan Karina Shor, University of Memphis, Memphis, TN
Christine Verdream, University of Memphis, Memphis, TN

SUPPORT AWARDS FOR FIRST-GENERATION UNDERGRADUATE STUDENT MEMBERS OF ASB

- **2019**

Kabryn Mattison, Appalachian State University, Boone, NC
Jennifer Turner, Kennesaw State University, Kennesaw, GA
Brandon Jack, Kennesaw State University, Kennesaw, GA

ASB STUDENT RESEARCH AWARD ($1000) – SPONSORED BY ASB PATRON MARTIN MICROSCOPE

- **2019** - **Steven Gardner**, Auburn University, Auburn, AL
  Natural tissue concentrations in adult Ambystoma maculatum *and larval DNA damage from exposure to arsenic and chromium*

Steven Gardner (left) receives the ASB Student Research Award from ASB President Ashley Morris.

ASB Senior Research Award ($1000)

- **2019** - **Carolina M. Siniscalchi**, Department of Biological Sciences, University of Memphis, Memphis, TN
  The systematic value of pollen morphology in Chresta Vell. ex DC. (Vernonieae, Asteraceae)

Carolina Siniscalchi (left) receives the ASB Senior Research Award from ASB President Ashley Morris.

ASB Student Oral Presentation Award – Animal Biology ($300)

- **2019** - **Melissa Encinias**, James Madison University, Harrisburg, VA
  Divergence of male mating preferences in sympatric Calopteryx aequabilis *and* C. maculata *populations*

ASB Student Oral Presentation Award – Aquatic Biology ($300)

- **2019** - **Christa Edwards**, University of Tampa, Tampa, FL
  Antrhopogenic sound in the sea: are ascidians affected?

Christa Edwards (left) receives the ASB Student Oral Presentation Award – Aquatic Biology from ASB President Ashley Morris.

ASB Student Oral Presentation Award – Cell and Molecular Biology ($300)

- **2019** - **Tania Perez**, Miami Dade College, Miami, FL
  Investigating the assembly pathway for the yeast mitoribosomal small subunit

ASB Student Oral Presentation Award – Microbiology ($300)

- **2019** - **Eric Weingarten**, University of Mississippi, Oxford, MS
  Microbial community compositional and functional differences observed along wetland salinity transects

ASB Student Poster Presentation Award – Animal Biology ($300)

- **2019** - **Josh Hendricks**, Eastern Kentucky University, Richmond, KY
  Population dynamics and unique foraging ecology of copperheads in the Red River Gorge, KY

ASB Student Poster Presentation Award – Aquatic biology ($300)

- **2019** - **Wesley Franklin**, Southern Arkansas University, Magnolia, AR
  Microfiber prevalence and abundance in freshwater fishes from Lake Columbia, AR

ASB Student Poster Presentation Award – Cell and Molecular Biology ($300)

- **2019** - **Noha Shendy**, University of Memphis, Memphis, TN
  The epithelial stem cell phenotype is controlled by the expression and activity of NF-KB family members

ASB Student Poster Presentation Award – Microbiology ($300)

- **2019 - Madison Studstill**, Union University, Jackson, TN
  Biofilm formation and virulence factors of Candida albicans *in JEG-3 cell line*

Madison Studstill (right) receives the ASB Student Poster Presentation Award – Microbiology from ASB President Ashley Morris.

AFFILIATE RESEARCH AND PRESENTATION AWARDS

NORTH CAROLINA BOTANICAL GARDEN AWARD ($300)

- **2019** - **Logan Clark,** Appalachian State University, Boone, NC
  Blazing new paths to investigate blazing stars: Development of microsatellite markers and evaluation of species boundaries between Liatris helleri *and* Liatris turgida

Logan Clark (left) receives the North Carolina Botanical Garden Award from award committee chair, Johnny Randall. Logan also received an ASB Support award.

SOUTHEAST CHAPTER OF THE ECOLOGICAL SOCIETY OF AMERICA – EUGENE P. ODUM AWARD ($500)

- **2019 - Nicholas Flanders**, Old Dominion University, Norfolk, VA
  Effects of environmental conditions on survival of a bird-dispersed mistletoe, Phoradendron leucarpum

Nicholas Flanders (left) receives the Eugene P. Odum Award from ASB President Ashley Morris.

SOUTHEAST CHAPTER OF THE ECOLOGICAL SOCIETY OF AMERICA – ELSIE QUARTERMAN-CATHERINE KEEVER AWARD ($500)

- **2019 - Zoe Bergman**, James Madison University, Harrisburg, VA
  Response of restoration chestnut seedlings to forest management strategies

SOUTHERN APPALACHIAN BOTANICAL SOCIETY – RICHARD AND MINNIE WINDLER AWARD

- **2019**

  Peter W. Schafran, Elizabeth A. Zimmer, W. Carl Taylor, and Lytton J. Musselman
  A whole chloroplast genome phylogeny of diploid species of Isoetes *(Isoetaceae, Lycopodiophyta) in the Southeastern United States*

  Timothy M. Shearman, G. Geoff Wang, Robert K. Peet, Thomas R. Wentworth, Michael P. Schafale, and Alan S. Weakley
  A community analysis for forest ecosystems with natural growth of Persea *spp. in the Southeastern United States*

SOUTHERN APPALACHIAN BOTANICAL SOCIETY – EARL CORE STUDENT RESEARCH AWARD ($750)

- **2019** - **Cheyenne Moore**, Bucknell University, Lewisburg, PA
- **2019** - **Mason McNair**, University of Georgia, Athens, GA

SOUTHERN APPALACHIAN BOTANICAL SOCIETY – JOHN E. FAIREY SCHOLARSHIP FOR STUDY AT A BIOLOGICAL FIELD STATION

- **2019**

  Venus Jafari, University of Virginia, Charlottesville, VA
  Mountain Lake Biological Station - Plant Diversity, Evolution, and Conservation

  Brandy Benz, North Carolina State University, Raleigh, NC
  Highlands Biological Station - Fern Identification and Ecology

  Robert Helsel, Rutgers University, New Brunswick, NJ
  Eagle Hill Institute - Mosses: Structure, Ecology, and Identification

  Aryan Kadkhodaei, University of Virginia, Charlottesville, VA
  Mountain Lake Biological Station - Plant Diversity, Evolution, and Conservation

SOUTHERN APPALACHIAN BOTANICAL SOCIETY – OUTSTANDING STUDENT ORAL PRESENTATION AWARD ($300)

- **2019** - **Marietta Shattleroe**, Appalachian State University, Boone, NC
  Investigations of the forgotten Geum, Geum geniculatum Michx., Bent Avens

Jonathan Horton (left) professor of Biology at UNC-Asheville congratulates Marietta Day Shattleroe for receiving the SABS Outstanding Student Oral Presentation Award. Marietta also received an ASB Support Award.

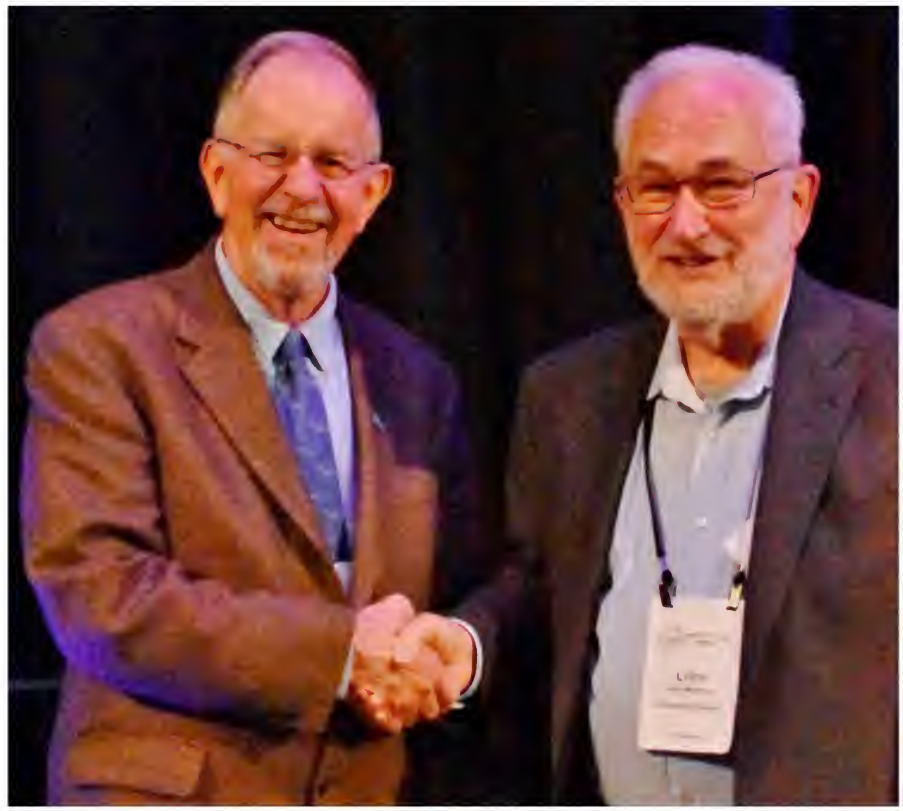
SOUTHERN APPALACHIAN BOTANICAL SOCIETY – OUTSTANDING STUDENT POSTER PRESENTATION AWARD ($300)

- **2019** - **Claire Ciafre**, Southeastern Grasslands Initiative, Clarksville, TN
  The confluence of disjunct plant species in a remarkable Eastern Highland Rim seepage grassland, Putnam County, Tennessee

SOUTHERN APPALACHIAN BOTANICAL SOCIETY – ELIZABETH ANN BARTHOLOMEW AWARD (1,500)

- **2019** – **Michael E. Held**, Saint Peter's University, Jersey City, NJ

This award was presented to Dr. Michael E. Held for his outstanding contributions to education and service to the Southern Appalachian Botanical Society. Mike is Professor of Biology at Saint Peter's University where he has dedicated a career to excellent teaching and student advising service. Saint Peter's is mostly a teaching institution. Mike's research interests are in forest ecology and he has some publications in that area of botany. Mike has served SABS in many ways. He was membership secretary for 11 years, and as well as both president-elect and president. While membership secretary, he started a computer database for membership and email contact to the society.



Michael Held (left) receives the Elizabeth Ann Bartholomew Award from award committee member Lytton Musselman.

SOUTHEASTERN SECTION OF THE BOTANICAL SOCIETY OF AMERICA – OUTSTANDING STUDENT ORAL PRESENTATION AWARD

- **2019** - **Brandon Fuller**, University of North Georgia, Dahlonega, GA
  The phylogeography of the southeastern species of the genus Dalea *L. (Fabaceae) using a phylogenetic approach*

SOUTHEASTERN SECTION OF THE BOTANICAL SOCIETY OF AMERICA – OUTSTANDING STUDENT POSTER PRESENTATION AWARD

- **2019** - **Annelise Kim**, Georgia Southern University Armstrong Campus, Savannah, GA
  Investigating phenotypic plasticity of Hydrocotyle bonariensis *in response to soil type and salt spray*

ASB CAREER AWARDS

ASB JOHN HERR LIFETIME ACHIEVEMENT AWARD

- **2019** - No award made this year

ASB MERITORIOUS TEACHING AWARD

- **2019** - **Lytton Musselman**, Old Dominion University, Norfolk, VA

Lytton Musselman (left) receives the ASB Meritorious Teaching Award from award committee member Howard Neufeld.

ASB Lucrecia Herr Outstanding Biology Teacher Award

- **2019 - Thomas Cox**, Brentwood Academy, Brentwood, TN

Thomas Cox (center) receives the ASB Lucrecia Herr Outstanding Biology Teacher Award from Education Committee Chair Holly Boettger-Tong (right) and ASB President Ashley Morris (left).

ASB Executive Committee Members who attended the 2019 Annual Meeting

From left to right: Ashley Morris, J. Christopher Havran, Christopher Gissendanner, Tracy Deem, Rebecca Cook, Alfredo Leon, Holly Boettger-Tong, and Christopher Brown.

Pictures are courtesy of Dr. Patricia Cox. We thank you.

ASB Oral Presentation Abstracts

1 - Dendroecology of Carolina hemlock (*Tsuga carolinana* Engelm.) stands in the southern Appalachian Mountains

Marcus Wind[1], Laura DeWald[2], Tara Keyser[1], Beverly Collins[2]

[1]Western Carolina University, Asheville, NC, [2]Western Carolina University, Cullowhee, NC

Carolina hemlock occurs only in small isolated populations in the southeastern United States. It is a species of concern, threatened by *Adelges tsugae*, climate change, and altered disturbance regimes. Lack of quantitative information regarding long-term patterns of stand development, past disturbance regimes, and forest succession greatly limit the ability to conserve and/or restore these at-risk communities. This project described structure and composition of current Carolina hemlock stands, their stand development patterns, and successional trajectories to better understand the processes that influence this threatened forest community. At each of five sites, four 0.05 ha fixed-radius plots were established. Physiographic data collected included elevation, slope position, aspect, landform index, and terrain shape index. Biotic data collected included species composition, basal area, horizontal forest structure, age structure, site index, and canopy density. Changes in the demographics of stands, determined using dendrochronology and stand-age structure analysis, were used to describe current and past forest composition which illustrate successional dynamics. Of the 1,867 total overstory trees sampled, 1,246 were sound enough to core, which includes 635 of the possible 950 Carolina hemlocks examined. Carolina hemlock stands were associated with cliffs inside bowl shaped depressions near bodies of water where the higher humidity and/or lower temperatures perhaps created micro-habitats that mimic a past climate where Carolina hemlock thrived throughout the northern hemisphere. Most sites contained many mature *Pinus pungens* and *Pinus rigida* snags and many young *Pinus strobus* suggesting Carolina hemlocks usurped habitat previously dominated by hard pines which is now being invaded by *Pinus strobus*. Only 25% of the plots had more smaller diameter trees than larger ones suggesting relatively poor rates of regeneration in the majority of Carolina hemlock populations sampled.

2 - Survey of rare plants within a calcareous flatwoods community and analysis of plant-environmental relationships

John Patten Moss, Natalie Bailey, William Walker, Martin Cipollini

Berry College, Mount Berry, GA

The Southern Ridge and Valley Calcareous Flatwoods community is described as having a diverse understory and shrub layer and unique plant associations. Atypical edaphic processes may contribute to the presence of disjunct or nearly endemic species, including several federal and state endangered and rare species. Characteristic habitat is purported to be flatwoods areas at Berry College (Floyd County, GA). To evaluate this community, we surveyed a 238-hectare study plot traversing varying canopy conditions. Contiguous 30-m wide strip transects were surveyed for 12 focal species in summer 2018. Hemispherical canopy photos were taken at points where focal plants were found, and soil samples were taken from 10 locations within 15-m. Soil samples and photos were also taken at 30 random locations within the study plot. Soils were analyzed for pH, lime buffer capacity (LBC), Ca, Mg, P, K, Mn, and Zn. Canopy photos were analyzed for variables related to canopy openness. Only the state imperiled *Asclepias hirtella* (N = 52) and the US threatened and state imperiled *Marshallia mohrii* (N = 12) were located during the survey. Contrary to expectations, this habitat was not uniformly high in Ca (ranging from ~40-4000 mg/kg, mean 602 mg/kg) or pH (ranging from ~3.7-6.9, mean 4.8). Locations where focal species were found differed significantly from random locations in buffering capacity (lower for both species), pH and variables positively related to canopy openness (higher for *A. hirtella*), Mg (higher for both species), K, Zn and leaf area indices (lower for *A. hirtella*), and Mn (higher for *M. mohrii*). Principle components analysis supported these results, suggesting that *A. hirtella* was associated with relatively higher canopy openness and pH, Ca, and Mg, and lower LBC, K, and Zn. Spatial autocorrelation analysis will help determine if these patterns were true indicators of habitat requirements for the target species.

3 - Use of DNA Barcoding as an Effective Tool in Earthworm Identification and Diversity Analysis in Native and Exotic Plant Plots

Bailee Powell, Erin Laubacher, Chris Barton, Darlene Panvini

Belmont University, Nashville, TN

Soil dwelling organisms play a major role in supporting ecosystems by creating biomolecules necessary for life, and assessment of their diversity can indicate the health of ecosystems. There are over 6000 species of earthworms, many of which are still unknown. Earthworms have a high cryptic diversity and differentiating morphological characteristics arise only after sexual maturity, thus presenting a challenge in identifying juvenile individuals. This study had two objectives: 1) assess the diversity of earthworms in plots dominated by native and exotic plant species, and 2) determine the effectiveness of DNA barcoding as a tool in species identification of earthworms in both adult and juvenile stages. It was hypothesized that 1) exotic plots would have greater earthworm diversity and 2) DNA barcoding would be successful in the identification of both adult and juvenile earthworms. Earthworms were collected from plots dominated by both native and exotic plants using vermifuge techniques at Belle Forest Cave Property in Nashville, Tennessee during the months of September to November 2018. Using earthworm taxonomy books and stereoscopes, the adult worms were identified to use as a comparison for species identification through barcoding. For each worm, DNA was then isolated, sequenced, and compared to a database of gene sequences for species identification. DNA barcoding proved to be an effective tool for juvenile species identification and provided more accurate results for the adults than identification based solely on morphological characteristics. The biodiversity among the native and exotic plant plots was determined by comparing the number of different earthworm species collected and identified. Different from our hypothesis, the native plant plots contained more earthworm diversity than the exotic plant plots.

4 - Setting restoration and management goals for upland-embedded wetlands based on research of biological, geospatial, and hydrogeological data in the Daniel Boone National Forest, Kentucky

Stephen C. Richter, Rachel Fedders, Kelly Watson, Jonathan Malzone, Matthew McClure, Luke Dodd

Eastern Kentucky University, Richmond, KY

Upland-embedded wetlands (UEWs) are depressional wetlands surrounded by uplands. On the Appalachian Plateau, these ephemeral to semi-permanent wetlands are a critical component of the ecosystem because they provide habitat for amphibians and invertebrates, feeding and watering sources for reptiles, mammals, and birds, and suitable conditions for wetland plants. In the Daniel Boone National Forest, hundreds of UEWs have been constructed on ridge-tops to provide permanent water sources for deer, turkeys, and bats. Very few of the constructed UEWs dry, so management techniques were successful based solely on hydroperiod. However, our biological, geospatial, and hydrogeologic research conducted over the past decade suggests a need for revisiting the management approach. Our hydrogeologic and geospatial research contrasted wetland topographic position, density, surface-ground water connectivity, hydraulic conductivity, and evapotranspiration relationships between natural and constructed UEWs; biological research focused on distribution and abundance of amphibian, bat, and plant assemblages in relation to wetland characteristics. In general, constructed UEWs are present at much higher densities on the landscape, are permanent and isolated from groundwater due to extreme soil compaction, and have different assemblages than natural UEWs. Based on our interdisciplinary findings, management efforts should focus on conserving existing natural UEWs, reducing density of constructed UEWs, and restoring some constructed UEWs to natural-like condition. Constructed UEWs that are candidates for removal are those with the least natural characteristics, including greater depth and having large populations of eastern newts and green frogs, and in areas of highest density. Constructed UEWs with natural characteristics and natural UEWs that have been anthropogenically altered are candidates for restoration. As true for any restoration project, we recommend a careful, data-driven approach to ensure the resulting habitat will meet desired ecological and functional goals and not disrupt existing ecosystem structure. Restored wetlands should be monitored for at least five years to determine success.

5 - Comparisons of plant communities at natural and constructed upland-embedded wetlands in the Daniel Boone National Forest, Kentucky

Rachel Fedders, Stephen C. Richter

Eastern Kentucky University, Richmond, KY

Upland-embedded wetlands (UEWs), depressional wetlands surrounded completely by uplands, provide important habitat for plants and other species. Upland-embedded wetlands have been constructed in many locations for conservation and mitigation purposes. However, constructed UEWs often have longer hydroperiod, less canopy closure, and are typically more disturbed than natural UEWs. We compared vegetation at natural and constructed UEWs to examine community composition, functional group structure, richness, and ecological conservatism. We evaluated plant communities at 10 natural and 10 constructed UEWs on the Cumberland Plateau within the Daniel Boone National Forest (DBNF), Kentucky. Community analysis indicated clear differences between natural and constructed wetland types. Natural wetlands had high canopy closure and short hydroperiod compared to constructed wetlands, which tended to be permanently inundated and open-canopy. Natural wetlands also had higher ecological conservatism, higher floristic quality, and lower native and nonnative species richness than constructed wetlands. Functional group structure differed between types, with constructed wetlands having a greater proportion of annual and perennial forbs, and natural wetlands having a greater proportion of woody species. Constructed wetland indicator species were disturbance-tolerant with high light requirements. Natural wetland indicators were tolerant of shade and less tolerant of anthropogenic disturbance. Ephemeral hydroperiod, high canopy closure, and lack of disturbance at natural sites have led to higher floristic quality and a greater proportion of shade-tolerant and woody understory species. Disturbance at constructed wetlands has contributed to low floristic quality, low ecological conservatism, and nonnative species invasion. Lower richness at natural wetland sites is not a sign of low ecological quality but is rather a function of habitat. Further research is needed to separate the effects of construction history, canopy closure, and hydroperiod on UEW plant communities. Knowledge of natural plant communities should be used to inform restoration and management of constructed UEWs in the DBNF and elsewhere.

6 - Macro-ecological scale geographic variation of a keystone predator in a common garden environment

Kenzi Stemp[1,2], Tom Anderson[1,2], Brittany Ousterhout[3], Jon Davenport[1]

[1]Appalachian State University, Boone, NC, [2]Southeast Missouri State University, Cape Girardeau, MO, [3]National Great Rivers Research & Education Center (NGRREC), East Alton, IL

Geographic variation in species behavior and life history has been well documented in biology. Species with wide geographic distributions (i.e. across a continent) and small home ranges (i.e. <2km^2) are especially likely to experience variability in abiotic environments across the entirety of their range, and possibly strong local adaptation. This can result in potential differences in species interactions. Understanding variation on a geographic scale is especially important when considering species of ecological importance, such as keystone species. Yet, few studies have compared the potential cascading ecological effects of keystone predators on a macro-geographic scale. To understand how keystone ability in pond food webs can vary across a large geographic range, we conducted an artificial pond experiment predator that is known to be a keystone predator in at least part of its range, the marbled salamander (*Ambystoma opacum*). To do so, we collected size-matched salamander larvae from three geographically distant populations (>650km apart) in Ohio, Mississippi, and North Carolina and placed them in mesocosms with a suite of spring breeding amphibian prey species. Additionally, we quantified zooplankton abundance and primary productivity to better understand ecosystem-level effects of this keystone predator. Preliminary results indicate differential survival of some tadpole species leading to differences in anuran diversity among the three predator populations. Tadpole diversity was lowest in the most northern populations (i.e. Ohio) of salamanders indicating that keystone function may vary at a geographic scale. Further understanding of large-scale variability in ecologically important predators is needed to direct future conservation efforts and preserve biodiversity.

7 - Can cues about pitcher morphology explain differences in colonist abundance between Sarracenia purpurea and their hybrids?

Rebecca Hale, Wayne Morgan, Caroline Kennedy, Jennifer Rhode Ward

University of North Carolina Asheville, Asheville, NC

Pitchers of the purple pitcher plant, *Sarracenia purpurea*, are distinctly shorter and broader than those of other *Sarracenia*, which allows them to hold pools of rainwater. These phytotelma are subsequently colonized by a diverse invertebrate and microbial community. *S. purpurea* readily hybridizes with congeners to produce rosettes with morphologically intermediate pitchers, which are colonized by a similarly diverse, but less dense, community. The goal of our ongoing work is to address why hybrids consistently harbor fewer colonists in their pitchers. One explanation is that organisms are less likely to colonize them. If so, then these organisms must use cues to distinguish among taxa. Here, we characterize morphology of *S. purpurea* var. *montana* and their hybrids with *S. jonesii* (mountain sweet pitcher plant) in the mountain bogs of Western North Carolina to determine whether historically subjective differences in shape and stature between *S. purpurea* var. *montana*, *S. jonesii*, and their hybrids are quantifiable. Then, we examine whether community diversity or number of colonists varies with pitcher morphology. If so, then potential colonists may be using visual cues of shape to identify favorable pitchers.

8 - Contributions from the University of South Florida to the flora and mycoflora of the southeastern USA

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Institutional collaborations and online communities are rapidly improving the understanding of the biota of the USA, such as SERNEC and BONAP for plants and MyCoPortal and Mushroom Observer for fungi. Here we summarize the contributions to these projects from the University of South Florida Herbarium (USF). Approximately 72% of the 300,000 vascular plant specimens at USF are digitized, and for 9 states of the southeastern USA all are completely digitized. For these nine states and their ~7,000 species of vascular plants, USF has about 71,000 county records represented (AL, 2600; AR, 1000; FL, 45,000; GA, 3200; LA, 4500; MS, 4300; NC, 4600; SC, 3800; TN, 1800). The fungi are surprisingly poorly studied in Florida. Analysis of MyCoPortal records for Florida indicates collecting activity peaked in the 1940s and about 50% of efforts were concentrated in Alachua County. Recent work by collaborators at FIU, UF, USF, and citizen scientists are dramatically improving understanding of macrofungi in Florida, with recent collections having high-quality DNA and field photos.

9 - The Effect of Rising Sea Level on Coastal Vegetation in South Carolina

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In the present study, we examine the effect of rising sea level, a product of global warming, on the distribution of coastal vegetation at five sites in South Carolina. Rising sea level with a concomitant increase in water salinity and duration of submergence is changing plant diversity in coastal salt marsh and brackish marsh communities. We present data at three brackish marsh abandoned rice fields, and a salt marsh at the Belle W. Baruch Institute for Marine Biology and Coastal Research, Georgetown County, and a fifth site, a skeleton live oak stand in southeastern Beaufort County. Rising sea level has impacted vegetation at the 3 abandoned rice fields reducing vascular plant diversity at the two least saline marshes, Air Port and Alderly. *Sporobolus alterniflorus* a salt marsh associate is now present at Alderly, the least saline abandoned rice field, testimony to rising sea level and increase in water salinity. The more flood tolerant *Borrichia frutescens* is replacing *Sporobolus pumilus* at the salt marsh at Clam Bank. A stand of live oak, *Quercus virginiana*, has been replaced by salt marsh taxa, *Salicornia virginica* and *S. alterniflorus* at the Beaufort County site. Sea level has been rising at a rate of 3 mm/yr since 1930 and may rise at a greater rate in the future, impacting the vegetation of the aforementioned communities and additional coastal marsh and upland communities along the east coast of the United States.

10 - Ready, Set, Go: The Southeastern Grasslands Initiative Launches Ecosystem-Specific iNaturalist Projects in 2019 to Gamify Biodiversity Documentation from the Southern Grassland Biome

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The Southeastern Grasslands Initiative is a new conservation organization with a mission to understand, preserve, and promote grassland ecosystems of the southeastern U.S. Our organization is committed to engaging citizen scientists of all ages to collect critical biodiversity data from the imperiled Southern Grassland Biome. iNaturalist has revolutionized the process of collecting such data and makes identification much more accessible to the general public. Most iNaturalist projects are associated with parks, urban areas, public lands, or political units. To date, we have established >65 projects in 13 states from Arkansas to Virginia and Florida to Illinois. Each individual project (collection projects) focuses not on a political area or arbitrary boundary but rather on a specific plant community type (e.g. Cumberland Plateau Escarpment Limestone Barrens) within a given ecoregion. Collection projects are grouped into one of 11 umbrella projects. For example, the "Limestone Glades & Barrens of Eastern Unglaciated U.S." umbrella project includes 15 types of calcareous (limestone, dolomite, siltstone) glade and barren ecosystems. On each collection project page, we have included a representative habitat photo along with SGI's logo, observation photos and observation statistics, and a map of that grassland community. On our website (https://www.segrasslands.org/biodiversity-exploration/), we have created a 10-module online course to train volunteers. In spring 2019, SGI will embark on an ambitious goal to empower and train 500 volunteers (biodiversity explorers) to collect data from these communities. By late 2019, we expect to have established more than 100 SGI grassland projects across our 23-state focal region. This project will enable us to capture comparative data on the biodiversity of dozens of distinct types of Southeastern grassland ecosystems. In under-surveyed plant communities, we will also document biodiversity by continuing/escalating traditional voucher-based studies to generating high-quality biodiversity collections to be deposited in herbaria and museums across the Southeast.

11 - A Reevaluation of Tennessee's Non-Native Plant Species Using Online Herbarium Specimen Data to Develop Species Distribution Models

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Almost 17% (486) of the plant species in Tennessee are non-native to the state. These species are a substantial threat to the native flora and native ecosystems in Tennessee and as such they are a problem for conservation. Detection, and ultimately monitoring, of these species present tremendous challenges to conservation groups. As a first line of defense, organizations such as the Tennessee Invasive Plant Council (TN-IPC), work to rank invasive plant species with regard to their invasiveness. Ultimately, the ranking of invasive plants is used to draw attention to the most aggressive species, determine research priorities, create policy, and provide information to land managers. To rank invasive plant species, the TN-IPC has relied heavily on expert opinion and experience. In December 2018, we searched the SERNEC database for all records of the 486 non-native species of Tennessee that were collected within the political boundary of Tennessee. This search revealed major discrepancies between species collected throughout the state and TN-IPC's ranking system. The discrepancies revealed by this study indicate either a strong collection bias or they question the legitimacy of relying heavily on expert opinion alone, or both. In an effort to test the hypothesis of TN-IPC's ranking of Tennessee's non-native plant species, we will use locality data from herbarium specimens to create Maximum Entropy models to simulate the potential distribution of 33 different invasive plant species in Tennessee that are currently listed as threats by the TN-IPC to ultimately reevaluate the potential invasiveness of these species.

12 - Rescuing an imperiled collection: The integration of the Western Kentucky University Herbarium (WKU) into Austin Peay State University (APSC)

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In the past 20 years, support for small herbaria in Kentucky has rapidly declined. From the high point of eight active herbaria in the 1990's, only four remain active, with the other five either closed or imperiled. The Western Kentucky University Herbarium (WKU), consisting of 68,000 specimens, had been scheduled to be closed by May of 2016. In order to rescue the WKU collection from abandonment, Austin Peay State University Herbarium (APSC) applied for and was awarded a National Science Foundation grant. The WKU collection, the second largest in Kentucky, had itself integrated the University of Louisville collection just eight years earlier. These combined collections are of immense scientific value, containing the majority of herbarium specimens from the Mammoth Cave Hills and Pennyroyal Plain ecoregions, the latter of which includes remnants of a now nearly extinct tallgrass prairie and savanna system. In addition, WKU housed the private collection of Max Medley, consisting of 22,000 specimens, which remained in a mostly unprocessed state. The Medley collection includes many rare and noteworthy species as a result of his work with the Kentucky State Nature Preserves Commission, including undistributed type specimens. Over the past two years, all specimens from WKU have been transferred to APSC, and are currently being databased, photographed, and organized into the main collection. In addition, the entirety of the previously-unprocessed Medley collection has been labeled and mounted. Over the course of this integration APSC has grown from a collection size of ~50,000 specimens to over 100,000, making it one of the leading herbaria in the Mid-South region. Due to this support from the National Science Foundation, the WKU collection is now safely secured at APSC, with roughly a year left to completion.

13 - Small herbaria significantly contribute unique biogeographic records to county-, locality-, and temporal-level scales

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The urgency to have detailed knowledge of plant species' distributions has never been greater, given the negative impacts humans are currently having on global biodiversity. Therefore, it is imperative to develop strategies about which datasets should be included when consulting natural history collections to understand these distributions. While redundancy in collections has value, priority should be placed on unique records in order to gain a better understanding of species' distributions over time. We asked at which levels small herbaria (i.e., those with fewer than 100,000 specimens) contribute uniquely: county-, locality-, or temporal-level scales. In our subset of 8 US states, small herbaria contributed approximately 30% of the records in our dataset. We found that small collections do not contain redundant specimens with large herbaria. In fact, in our sampling of 40 species per state, we found that small herbaria contributed no less than 20% of the unique records at county-, locality-, and temporal-level scales, and in some cases (S2 rare, e.g.) contributed to the county-level distribution significantly more than expected by the number of records contributed. This quantitative set of results is profound because we show that small herbaria generally contribute unique information in proportion with their number of accessioned specimens. Factors driving the patterns of variation in the data will also be discussed. It has long been recognized that small herbaria have important roles in training and education, but our research now quantitatively shows the unique contributions that small collections make to our understanding of biodiversity patterns. These collections cannot be excluded from data aggregation projects if we want a complete understanding of species distribution in space and time.

14 - "Born digital," addressing the challenges of a field-to-database workflow for collections based research.

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Biologists conducting field research, such as floristic studies, accession thousands of records into natural history collections. Most of these records are now available through online portals such as iDigbio and SERNEC. These portals are becoming invaluable research tools, even though their digital records are often incomplete transcriptions of the physical counterparts. For example, only 52% of *Plantae* records on iDigbio contain the date of collection. Yet, among those with date of collection there is a mean annual accession rate of over 170,000 records (2005 - 2015). The emergence of these portals imposes an additional responsibility for collection managers, the complete and accurate transcription of new accessions. "Born digital" records, those which have had their associated data initially gathered in digital formats circumvent this transcription process. Here we introduce the public releases of collNotes and collBook, combined they are a field-to-database solution designed to gather and format "born digital" field notes into database ready formats. A mobile application, collNotes was developed for Android and iOS devices to gather Darwin Core formatted field notes. A desktop application, collBook was developed for Linux, OS X, and Windows to refine those field notes into portal ready Darwin Core files and specimen labels. Field note refinements include: reverse geocoding localities, taxonomic alignments, and creation of customizable labels which can optionally include catalog number barcodes.

15 - Using Convolutional Neural Networks to Classify the Reproductive State of Digitized Herbarium Specimens

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The digitization of natural history records, such as herbarium specimens, is generating a large dataset with many unexplored novel applications. Concerted efforts of curators, researchers, volunteers, and the National Science Foundation has made over 16 million *Plantae* records, with associated images available on open portals such as iDigbio and SERNEC. A majority of these records are incomplete, lacking among other fields reproductive state information, a vital data point for large scale biological research questions. Manual transcription of these missing data is expected to be labor-intensive and error prone. Automation through convolutional neural networks may be a viable alternative to manual transcriptions. We present the results of detecting the reproductive state of herbarium specimens using convolutional neural networks, and other machine learning techniques. Specimen images were retrieved from SERNEC and processed using neural networks. Transfer learning and depthwise convolutions were used to enhance the performance and accuracy of these networks.

16 - Investigation of Thermal Heterogeneity as a Driver of Thermoregulation and Plasticity using the Differential Grasshopper (Melanoplus differentialis)

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Thermoregulation, the ability of an organism to maintain a certain mean or variance of its internal temperature that differs from the mean or variance of its external environment, is ubiquitous across taxa and has been well documented. Less well understood is what drives the evolution or maintenance of the ability to thermoregulate. We used the differential grasshopper, *Melanoplus differentialis*, to test for a correlation between environmental thermal heterogeneity and thermoregulatory capacity. We collected individuals from five sites over a 1,796 km span that, over a 101-year period, varied in their degree of thermal heterogeneity. We used these individuals to produce an F1 generation that we tested for upper and lower thermal limits. In addition, we used them to produce an F2 generation, utilizing a split-brood design to rear them in a cool and warm environment. We used the resulting data from both generations to answer the following questions: 1) Do *M. differentialis* from more thermally heterogeneous sites thermoregulate more effectively? 2) Are

M. differentialis from more thermally heterogeneous sites more plastic in thermoregulation in response to variable rearing temperatures? Our results are mixed, but indicate that variability in the ability to thermoregulate does exist among the populations we examined. Furthermore, when differences are significant, individuals from more thermally heterogeneous sites have greater thermoregulatory capacity and are more plastic.

17 - Reproductive life history and shell shape variation of three species of Elimia (Pleuroceridae) in the Lower Etowah River Basin.

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Pleurocerid snail diversity in the Southeastern United States is thought to be high, but estimates of overall diversity are compromised by uncertain taxonomy. This is particularly true for the genus *Elimia*, where reliance on conchological characters described by early naturalists for species designation failed to recognize significant variability in shell morphology. In this study we examine three putative species of *Elimia* to determine if quantifiable conchological characters are associated with differences in life history characteristics. Individuals of *E. modesta*, *E. carinocostata*, and *E. carinifera* were collected from nine sites in three streams in the lower Etowah River Basin. Females were separated by species and placed in mono-specific tanks where egg deposition could be monitored. Shell shape was assessed using Geometric Morphometrics. Although there was some overlap, shell shapes differ significantly among the three forms. Shell sculpture differences appear early in juvenile forms and the three species are distinguishable by the establishment of the fourth whorl. Differences in egg oviposition among species were observed in the lab and in substrate samples obtained from the field. Our results suggest that there are at least three distinct species of *Elimia* occurring in lower Etowah River Basin tributaries.

18 - Redescription and Circumscription of the Acuminate Crayfish, Cambarus acuminatus Faxon, 1884 (Decapoda: Cambaridae)

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Cambarus acuminatus was described by Walter Faxon in 1884 from three specimens collected in the Saluda River in northwestern South Carolina, USA; a form II male and two females. The types have since disappeared or deteriorated so as to be taxonomically useless. *Cambarus acuminatus sensu lato* has been acknowledged to comprise a species complex known as *Cambarus sp.* C. This complex ranges across much of the Piedmont Plateau and Coastal Plain from central South Carolina to Maryland and southeastern Pennsylvania. Because *C. acuminatus* lacks taxonomically useful type material and a detailed description, taxonomic reassessment and revision of this species complex has been problematic. For these reasons, we redescribed *C. acuminatus* based on modern standards for astacoidean crayfishes and provide a revised circumscription of the species. This lays the groundwork necessary for future taxonomic and phylogenetic work involving the *C. sp.* C complex.

19 - Examining the Antibiotic Effects of Hemolymph from Immune Challenged Squash Bugs (Anasa tristis)

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There is an increasing demand for natural antibiotic discovery to aid in the growing epidemic of antibiotic resistant bacteria. Insects represent a promising source for novel antimicrobial peptides. The antibiotic properties of the hemolymph from squash bugs (*Anasa tristis*) were tested against *Escherichia coli* in a growth inhibition assay. *Anasa tristis* groups were either immunized with a mixture containing *E. coli* and *Staphylococcus epidermidis* or un-immunized. The hemolymph from both groups was extracted, and a microplate assay was used to examine the immune response against the growth of *E. coli* as measured by optical density. The control groups for comparison included *E. coli* as the positive control and ampicillin as the negative control. A spread-plate technique was also used to compare post-assay colony growth for all tested groups. The growth curves after 16 hours showed that immunized and un-immunized hemolymph were both significantly

higher than the positive control (OD = .784/.788 vs. .338). Similarly, the colonies counted in immunized hemolymph had an average of 190 colonies and un-immunized hemolymph had an average of 40 colonies, which the immunized hemolymph was significantly higher than the positive control's average of 20 colonies. Overall, the microplate assay and colonies counted revealed no significant antibiotic activity in *A. tristis* hemolymph. It is possible that the hemolymph provided nutrients for *E. coli* rather than inhibiting bacterial growth. Future studies could use a cytometer to verify that an immune response occurred by counting plasmocytes present.

20 - Divergence of Male Mating Preferences in Sympatric Calopteryx aequabilis and C. maculata Populations

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An ongoing evolutionary question is how co-occurring species maintain reproductive barriers when they are morphologically, behaviorally, and ecologically similar. Without geographic isolation, mate choice often forms these barriers through species recognition of males by females. However, because females typically have a greater reproductive investment, variation between females and male choice is commonly overlooked. In *Calopteryx* damselflies, wing pigmentation is sexually dimorphic and females appear to prefer dark-winged males. When the geographic distributions and female preferences of related species overlap, there is potential for misdirected mating. However, in sympatric populations of *C aequabilis* and *C. maculata*, hybridization is not common. Female wings also dramatically differs when these species co-occur. Due to the divergence of females wings in sympatric populations, we hypothesize that this character is under selection for species recognition by males. We conducted mate choice experiments in which we altered female wings by switching them between populations or species. We then measured male mating behavior of both species. Our results supported our hypothesis, as sympatric *C. aequabilis* males had significantly different wing preferences than allopatric *C. aequabilis* and sympatric *C. maculata* males. This finding suggests that male mating preferences diverged in sympatric populations and potentially evolved as a reproductive barrier to reduce misdirected mating of two closely related species.

21 - A Treasure Trove of Biodiversity Revealed in a Southern Illinois Pollinator Inventory

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Conserving pollinator diversity is a growing concern. For example, long-term studies of a pollination network in central Illinois revealed species loss and pollinator network degradation. Bees, like other pollinators, depend on floral resources from native plants, so abundance and diversity of both groups are interdependent. Southern Illinois is known to be a biodiversity hotspot within the eastern U.S. This diversity likely stems in part from the fact that the area lies at the convergence of three major biomes: the eastern deciduous forest, the gulf coastal plain, and the Ozark uplift. These patterns suggest southern Illinois may also contain high diversity of bees; however, the region remains inadequately sampled with respect to bees and other pollinators. We conducted a two-year systematic inventory of pollinators and their floral associations in Southern Illinois, using a sampling regime stratified with regard to habitat types and land use. Standard sampling methods that included hand netting and pan traps were used during the flowering season of 2017 and 2018. Over 17,000 bees from 87 sampling sites in were collected, with over 350 floral associations. To date, over 200 species of bees have been identified. Significant findings include *Bombus pensylvanicus*, a species of growing conservation concern in more northern regions but that appears to be abundant in southern Illinois, at least 25 new state records for bees, and several putative undescribed species of *Andrena* and *Lasioglossum* (*Dialictus*). Moreover, southern Illinois harbors an unusual suite of mostly-southeastern bee species that are at the northwest edge of their ranges or even disjunct from their primary ranges. A bipartite network analysis reveals that non-native plants, including agricultural weeds, are well-connected in the network, and are important floral resources in disturbed and degraded habitats.

22 - Parasites and Plastics in Waterbirds Foraging Near Aquaculture Facilities in the Southeastern US

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Many waterbird species winter in and around aquatic systems in the southeastern US, with an increasing number interacting with aquaculture facilities. These habitats offer refuge and foraging opportunities, and consequently, can be areas where parasites and pathogens are transmitted among host organisms. Fishes can be exposed to pathogens from foraging and loafing birds, and birds foraging in these habitats can acquire parasites which can be problematic to their health. Birds can also be exposed to microplastic pollution - either within or outside of these aquaculture systems. Here, we assess the intestinal parasites and microplastic pollution in the digestive tracts of Double-crested Cormorants (*Phalacrocorax auritus*) and Lesser Scaup (*Aythya affinis*) foraging near/on aquaculture facilities. We compare the foraging ecology of these birds, (based on stable isotope values of their liver tissue), host demography (age, sex, body weight), and seasonality to the prevalence and abundance of microplastic pollution and helminthic parasites. In cormorants, nitrogen isotope fractionation differed among the sexes, which correlated with host body weight. These values also increased with collection date, suggesting that cormorants fed on higher-trophic order prey items while on the wintering grounds. Similarly, higher prevalences of plastic pollution were found in birds collected early in the winter season, suggesting more plastic was consumed on the breeding grounds or in stopover habitats during fall migration. Isotope signatures differed in *A. affinis* by both sex (carbon) and the type of fish being farmed (carbon and nitrogen). Individual parasite species infecting these hosts did not vary by season or host sex, but were associated with host trophic level, degree of pond use for foraging, and use of marine foraging grounds. Additionally, some parasite groups were found to be positively associated with plastic pollution (Cestoda: Platyhelminthes), while others were found to be rare when plastics were consumed by hosts (*Hysteromorpha triloba*).

23 - Life History Notes on the Rare Ectoparasitiod Wasp Rhopalosoma nearcticum

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Rhopalosoma nearcticum is a rare species of wasp from the under-studied family Rhopalosomatidae. These wasps are ectoparasites of crickets in their larval instar stages, but relatively little is known about their biology and life cycle. This research was conducted with the objective of observing the full life cycle of *Rhopalosoma nearcticum* in a laboratory setting, and to determine the presence of *R. nearcticum* at 2 study sites. Collections were performed from April-October 2018, at Cypress Grove Nature Park in Jackson, TN, and a section of the Shenandoah National Park in Waynesboro, VA. No parasitized crickets were collected in VA, and a total of 6 parasitized crickets were collected from the site in TN. Parasitized crickets were sustained until the larva pupated and buried itself. Pupae were kept in an incubation chamber to allow full maturation into adult. After 3 weeks they were then removed from soil for observation. One cocoon was dissected, and the larva was kept in a synthetic cocoon until the pre-pupa died 3 weeks later. The other 2 cocoons were placed back in soil in the environmental chamber. One adult wasp emerged, the other cocoon is predicted to emerge in March 2019.The results showed a large amount of crickets parasitized at the TN site, as well as a previously unrecorded host for *R. nearcticum*. One of the larvae from a *Hapithus agitator* host successfully emerged as an adult wasp.

24 - The long-term effect of different reforestation strategies on forest composition on Block Island, Rhode Island

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Understanding patterns of forest succession can help advise management plans within New England nature preserves. This study took place on Block Island, 13 miles off the coast of Rhode Island. The island has greater than 200+ years of farming practices. After 1960, conservation groups began reforesting the island using different strategies, such as activing planting with native and exotic tree species, mowing, and preventing further development. In 2018, woody vegetation was inventoried

along transects within four reforested sites. Sites were characterized as the following: actively planted with exotic and native tree species and mowed (AP-M), actively planted with exotic and native species with no mowing (AP-NM), passively managed (no planting or mowing) (NP-NM), and never deforested (F). Trees (>5 cm dbh) were measured and identified within 10m of four 20m transects at each site. Saplings or shrubs (< 5cm dbh, > 1 m in height) were counted and identified within 5m of each transect. Tree seedlings (10 cm to 1 m in height) were counted and identified within 1m of each transect. Soil samples were taken every 20m along each transect. Reforestation strategy had a significant effect on adult tree basal area and diversity (p-value < 0.001). AP-NM had a significantly greater basal area (38.06 m2/ha) compared to "NP-NM" (13.14 m2/ha). The greatest diversity of tree species was also found at "AP-NM" (H'=0.759) while the lowest diversity was at "AP-M", which was represented by one species (Prunus serotina)(H' = 0). Overall, seedlings were rarely encountered, but the greatest number of seedlings (660 individuals per ha) was found at "NP-NM", most of which were shadbush (Amelanchier canadensis). In conclusion, "AP-NM" significantly increased the diversity and basal area but had no effect on seedling recruitment in the understory. This is most likely due to the overpopulation of deer on the island.

25 - Community structure and species composition across an elevation gradient within a floodplain forest of the Congaree River, South Carolina, USA

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In floodplain forests, hydrological connections and sedimentation dynamics determine site specific heterogeneous microsite distributions leading to specific community structure and species composition. This study was conducted on the Congaree River within the Congaree National Park where a series of low relief fluvial landforms were representative of gradients in sedimentation rates and inundation periodicity and depth. Four 20x25 m plots were established along five roughly parallel transects with a spacing of approximately 60 m between transects and oriented perpendicular to the river channel. A variety of techniques were then employed to quantify and describe the species composition, species distribution, and plant community structure (tree, shrub, and herbaceous communities) across the floodplain gradient of the study area. Using diameter at breast height data, basal area and stem density were calculated for all species of saplings and trees within each sample plot. There was a distinct difference in the *a priori*blocking by perceived elevation zone and the community groups defined via *post-hoc*cluster analysis. Results of this study showed little relation between tree and sapling layer matrices raising questions about successional patterns in this system and suggesting manipulations to hydrology and sedimentation may be responsible for an influx of exotic species and may have changed successional patterns.

26 - Utilizing a remote sensing derived NDVI normal dataset and vegetation field data to assess post-fire effects and ecosystem recovery in the southern Appalachians

Diane Styers, Peter Bates

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Remote sensing allows for broad-scale assessment of burn severity and monitoring of post-fire ecosystem recovery across the landscape. While a variety of normalized burn ratio metrics (e.g., NBR, dNBR, RdNBR) have been used successfully for these analyses in Western U.S. forests, they have not been as effective in the East, particularly in areas of low to moderate burn severity. Previous work has indicated the normalized difference vegetation index (NDVI) is better at exposing subtle changes to vegetation post-fire, having an increased sensitivity to ecosystem responses, and this is consistent with findings from other regional studies. However, NDVI varies greatly over space and time based on environmental characteristics such as elevation, aspect, and climate. Further, NDVI saturates in densely vegetated areas, and can be falsely high due to shadows in the forest canopy, which vary greatly by time of day and year. In an attempt to establish an expected NDVI range for our study area in Great Smoky Mountains NP (GRSM), we utilized a 35-year Landsat-derived NDVI dataset created by the Numerical Terradynamic Simulation Group to develop an "NDVI normal." We utilized data from National Ecological Observatory Network (NEON) vegetation field plots in GRSM, some of which burned during the Chimney Tops 2 wildfire, to assess pre- and post-fire NDVI values

and compare these to corresponding NDVI normal values. Results indicate differences in NDVI normal values between burned and unburned areas, but these are not significant. It appears the severe drought occurring prior to the fires had a greater impact on NDVI values than the fires. Further, none of the NEON plots experienced high burn severity, so some fire effects could have been masked by the following growing season. We are currently comparing NDVI values to pre- and post-fire field plot data from other 2016 wildfire sites, and to site productivity.

27 - Plant-arthropod associations of the "Botanical Lost World"

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As arthropod populations continue to decline, it is imperative that sensitive ecosystems are continually monitored and associations between plants and arthropods are documented. The ketona dolomite glades of Bibb County, AL are prime examples of a sensitive ecosystems as they only occur over a very narrow range, contain 8 endemic species and over 60 species of conservation concern. We observed and tracked for three years the interspecific interactions between populations of plants and animals, specifically class Insecta, in Kathy Stiles Freeland Bibb County Glades Preserve. In May of each year, undergraduate students from the University of North Georgia used ecological field techniques to observe evidence of plant-arthropod associations, identified plants to genus or species, and collected/identified insects. Four habitat types were chosen to observe and compare associations: large glade, small glade, mixed hardwoods, and pinewoods. Principle component analyses were performed between the habitats for each year to determine if habitat type was a good indicator of association types and if associations changed over time. The associations varied by habitat type with variation seen between the glades themselves as well, but most variation was driven temporally by year. The size and the habitat type surrounding any glade greatly influences the associations and assemblages found in said glade, and time dictates which associations will be present overall across all ecosystems.

28 - Long-Term Effects of In-Stream Restoration on Biotic Assemblages in Sandy Bottom Streams in Fort Benning Military Installation, Ga

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In sandy bottom streams of the Coastal Plains ecoregion in the southeastern US, increased sediment deposition and altered hydrologic regimes associated with land cover change can reduce coarse woody debris (CWD) abundance and overall benthic habitat quality. Habitat augmentation is a common in-stream restoration method; however, little research has examined long-term (>10y) effects of such restorations. In 2003, CWD was experimentally added to 4 streams at Fort Benning Military Installation and compared to 3 unrestored streams to evaluate macroinvertebrate and habitat response to instream habitat augmentation. Effects 3y post-restoration were variable among streams, but generally indicative of increased ecological integrity with seasonal increases in % Ephemeroptera, Trichoptera, and Plecoptera (EPT) and EPT density in restored streams. In 2017, we seasonally (summer, fall, winter) sampled macroinvertebrates and fish (summer) in the same 7 streams to determine the long-term effects of restoration on stream condition. Macroinvertebrate sampling was performed via four Hester-Dendy samplers (H-D) equidistant throughout the reach. H-D's incubated for eight-week periods within each season. Fish assemblages were sampled via backpack electroshocking. Preliminary macroinvertebrate community analysis shows increased variation in %EPT and EPT density as compared to 3y post-restoration data with restored streams beginning to diverge from unrestored streams in EPT density with restored streams averaging 11.6 EPT/m^2 while unrestored streams average 9.8 EPT/m^2. Both restored and unrestored streams had increases in %EPT however, averaged 9.8% and 9.6% respectfully. Preliminary fish assemblage data shows a divergence in population size with restored streams averaging 113 more individuals per 100 meters of stream. The divergence of restored streams from unrestored streams are hinting toward in-stream restoration being an effective practice but, requiring a longer settling period for beneficial effects to occur within dynamic sandy bottom systems of the Coastal Plains.

29 - An Ornamental Plant Found Spreading Aggressively: Potential Invasiveness of Dryopteris erythrosora (Dryopteridaceae) in North America

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In the summer of 2017 while collecting plants for BIOL 3329K (Identification of Vascular Flora) at the University of North Georgia, one of the authors noticed a dense population of Dryopteris erythrosora (D.C. Eaton) Kunze in a disturbed suburban woodlot, located in Alpharetta, Georgia. A highly soriferous frond was collected from the population and later brought into the lab to be examined. The frond was confirmed as D. erythrosora, commonly called Autumn Fern or Japanese Shield Fern. Dryopteris erythrosora is an exotic fern native to Asia; it is often sold in nurseries in the United States for shade gardens and used in landscaping. A population survey at the site documented a large number of fertile fronds and the recruitment of young plants. To this point, Autumn Fern has not been considered to be invasive, but the data collected here and by other recent work suggests that D. erythrosora is capable of reproducing and maturing into well-established colonies in the wild.

30 - Chasing Nuttall: A Bicentenary Interpretation of Thomas Nuttall's Exploration of the Arkansas Territory

Theo Witsell

Arkansas Natural Heritage Commission, Little Rock, AR

2019 marks the 200th anniversary of the great botanist and naturalist Thomas Nuttall's year-long journey of discovery through the Arkansas Territory (present day Arkansas and Oklahoma). He would be the first trained naturalist to record observations and collect specimens in most of the territory. His first-hand account of this trip, later published as *A Journal of Travels into the Arkansa Territory in the Year 1819*, provides some of the earliest reliable information on the natural history of the region. His observations on the flora, ecology, and geology are detailed and correlated to specific dates and places, making them especially useful. These observations and his botanical specimens are the earliest surviving for much of the region and are central to our understanding of what it was like before it was forever altered by the ravages of human progress. To commemorate the bicentenary of Nuttall's trip, I've worked for the past several years on a "200 years later" reinterpretation of all the natural history observations he made in Arkansas Territory. This included retracing his route using both historical and modern datasets in a GIS, updating the nomenclature and taxonomy of all of the plants and animals he mentions, and weaving in my own observations gained over the past 24 years conducting field work for the Arkansas Natural Heritage Program. The aim is to provide a fairly detailed interpretation of Nuttall's natural history observations, and discuss changes in the landscape since his trip, specifically as they relate to ecological and biological diversity. The full bicentenary account will appear as a series of three or four heavily illustrated articles published during 2019 in *Phytoneuron* (www.phytoneuron.net), an open access botanical journal available for free online, and released seasonally to correspond with Nuttall's progress through Arkansas Territory two centuries ago.

31 - Characterization of Novel Clostridium difficile Virulence Targets: A Structural Biology Approach

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Clostridium difficile is a gram-positive bacterium associated with the nosocomial disease *C. difficile* infection (CDI) which causes inflammation in response to sporulation and toxin secretion. Because incidence and recurrence of CDI have increased dramatically in immunocompromised and elderly patients, these toxins have been studied for antibody-based therapies. However, proteins on the surface of and within *C. difficile* could also provide new, more efficient targets for prevention of disease. This study examined the uncharacterized *C. difficile* protein C9YJI8 using structural biology methods to identify its structure and potential functions. The objective was to recombinantly express, adequately purify via chromatographic methods, and obtain refined protein crystals for X-ray diffraction analysis. Protein crystallization is a critical step in identifying protein structure and requires varying factors for optimal protein crystal formation. It was hypothesized that isolated, refined crystals would grow in conditions that have a pH of 5-6 and at temperatures below 18°C. The protein

crystallized in select monovalent salts, polyethylene glycol of a low molecular weight, and between a pH of 5.5-6.5. The storage of crystal optimization trays at 4°C resulted in protein precipitation, suggesting that colder temperatures were unfavorable for crystal growth to occur. Further studies of this structural approach will aid in understanding the protein's potential role in bacterial survival or virulence, provide new information about the mechanisms involved in the virulence of *C. difficile,* and guide new therapeutic treatments for CDI.

32 - Combating drug resistance - Comparison of the antibiotic effect of Hydrastis canadensis extract and pure Berberine via Minimum Inhibitory Concentration assay

Luke Scott, Timothy Trott

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Herbal medicines are a mele of complex organic chemicals, making it difficult to ascertain their direct mechanism of action. In contrast to mainstream pharmaceuticals, it is argued that herbal medicines are effective because of multiple constituents working synergistically. The complexity of herbal medicines may give them advantages over simpler pharmaceuticals in combating antibiotic resistant microbes, but these advantages can be difficult to quantitate. Popular literature frequently espouses the healing properties of herbal medicines, but many of these claims are not scientifically supported. Many gains could be realized in public health and medicine if more research was aimed at validating / disproving commonly used remedies. "Home remedies" though scientifically unsupported may still be viable treatments for certain diseases. Goldenseal (*Hydrastis canadesis*) is commonly used as an herbal therapy to treat bacterial infections, particularly of the upper respiratory tract. In an attempt to provide an organized investigation of weakly supported remedies, this research shows that extracts from Goldenseal have a greater antibiotic effect than the alkaloid berberine, which is thought to be its primary active compound. Minimal Inhibitory Concentration assays were done with *Staphylococcus aureus* and found that the MIC of Goldenseal extract is over 150 thousand times lower than the MIC of pure berberine. The increased bactericidal effect of the Goldenseal extract suggests synergistic effects with other compounds in the extract. Elucidation of the synergistic elements of Goldenseal extract and their mechanisms of action would be useful in creating novel methods of decreasing bacterial resistance to antibiotics.

33 - Examining the presence of antibiotic resistant Escherichia coli in Nashville, TN's Cumberland River.

Rachel Hongo, Matthew Heard

Belmont University, Nashville, TN

The introduction of antibiotics to urban rivers is driving the emergence of antibiotic resistant bacteria. This emergence is of concern because urban rivers are often home to diverse assemblages of organisms and because these rivers often provide drinking water and places for recreation for urban residents. Assessing the scope of this problem is challenging because we often lack information on how commonly we find antibiotic resistant bacteria in many rivers. Here, we examined how often we find resistant bacteria in the Cumberland River, in Nashville, TN, which is home to numerous aquatic species and is the source of drinking water for Nashville residents. To do this, we collected water and sediment samples over a two-month period in summer 2018 and looked for signs of resistance to eight different types of antibiotics in a common bacteria species – *Escherichia coli*. We found that antibiotic resistance was common in *E. coli* collected from both the water and the sediment samples. In addition, when we found *Escherichia coli*, it always showed resistance to multiple antibiotics. Our findings indicate that antibiotic resistance emergence is occurring in the Cumberland River and could be of potential concern to both wildlife and human health in the future.

34 - Microbial Community Compositional and Functional Differences Observed Along Wetland Salinity Transects

Eric Weingarten, Colin Jackson

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Despite the wetland microbiome's role in nutrient cycling, little research has characterized the wetland bacterial community or its variability across salinities. We determined bacterial composition and enzymatic activity of 22 wetlands along the entire Gulf Coast and on the Atlantic Coast from northern

Florida to southern Virginia, including 9 tidally connected pairs of wetlands at the high- and low-end of salinity transects. Sites ranged in salinity from limnetic (0 ppt) to polyhaline (38.8 ppt). This space-for-time substitution is intended to model the potential turnover of the wetland microbiome in response to saltwater intrusion. At each site, five 30 cm-deep soil cores were taken and sectioned into surface and root zone portions. Sediment bacterial DNA was extracted from each sample and the V4 region of the 16S rRNA gene sequenced. The mineralization rates of cellulose, lignin, chitin, and organic phosphorus were inferred by colorimetric assay of the activities of phenol oxidase, peroxidase, phosphatase, β-glucosidase, and NAGase. Site was a significant factor in extracellular enzyme activity (MANCOVA, $p < 0.001$) and salinity was a significant covariate ($p < 0.001$). Peroxidase ($p < 0.01$), phenol oxidase ($p = 0.03$), and NAGase ($p < 0.001$) were significantly and negatively correlated with salinity. Both abundance-based and presence-absence-based dissimilarity metrics showed significant compositional changes between limnetic (0-0.5 ppt) and oligohaline (0.5-5 ppt), and mesohaline (5-18 ppt) and polyhaline (18+ ppt) marshes, indicating a strong possibility for high species turnover as salt marshes migrate landward in response to sea-level rise. A decrease in carbon mineralization in higher salinity marshes may allow for soil accumulation above the rate of SLR, expanding their reach and accelerating the observed species turnover.

35 - Detecting and Differentiating Pseudomonas species Within Soil, Water, and Plant Matter Following a Multiplex PCR Protocol

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Pseudomonas is a genus of gram negative bacteria that are often found within soil, plant matter, and water. There are a large number of sub-species of *Pseudomonas*, but the current study focused on *Pseudomonas aeruginosa, Pseudomonas fluorescens, Pseudomonas putida*, and *Pseudomonas syringae*. The purpose of the current study was to identify the species of a collection of environmental isolates previously determined to be in genus *Pseudomonas*. The samples were taken from soil, plant matter, and water. Bacterial cultures, DNA extraction, multiplex PCR, and DNA visualization were used to identify each sample. The multiplex PCR utilized can detect *Pseudomonas aeruginosa, Pseudomonas fluorescens, Pseudomonas putida*, and *Pseudomonas syringae*. From the results of this multiplex PCR, the current study concluded that samples from all four species of *Pseudomonas* were able to be detected, but some samples did not test into any of the species that were included in the assay.

36 - Characterization of Vibrio vulnificus from Timucuan Preserve Water and Oysters

Janel Clarisse Palomo

Jacksonville University, Jacksonville, FL

Thirty-one *Vibrio vulnificus* isolates were obtained from water and oysters of Florida's Timucuan Preserve, and their potential for virulence was analyzed using microbiological and molecular techniques. *V. vulnificus* are potentially pathogenic bacteria that reside in water with temperatures greater than 20°C and a salinity range of 5-25 ppt. Virulent strains of *V. vulnificus* can infect people through open cuts or wounds or the consumption of raw or undercooked shellfish, such as oysters. Infections cause gastrointestinal distress, wound infections, and septicemia. In some cases, amputations and deaths may occur. Water and oyster samples were collected during mid-tide from Sisters Creek in Timucuan Preserve, Jacksonville, FL and isolated on refined cellobiose-polymyxin B-colistin agar, a selective and differential growth media. Bacteria suspected to be *V. vulnificus* were then identified with matrix-assisted laser desorption/ionization time-of-flight mass spectrometry. The results from multiplex polymerase chain reaction targeting virulence-correlated genes, and microbiological techniques used to determined the presence of bacterial capsules, the ability to ferment mannitol, and hemolytic ability will be presented to examine the virulence potential of the thirty-one isolates identified as *V. vulnificus*.

37 - Biodegradation of a Common Herbicide, Metribuzin used in Louisiana

Thomas Phillips, Ramaraj Boopathy

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Metribuzin (4-amino-6-tert-butyl-3-(methylithio)-as-triazin-5(4H)-one) is a photosystem II inhibiting herbicide currently being used as a substitute for atrazine. Metribuzin is a triazinon class herbicide and known endocrine toxin like atrazine though approximately 1% as toxic. Biodegradation of metribuzin by bacteria from the soil of the USDA farm in Houma, LA, which has been exposed to atrazine for a few years, will be evaluated under aerobic and anaerobic conditions. Anaerobic conditions will include fermentative, nitrate reductive, sulfate reductive, and mixed reductive environments. Once a condition under which metribuzin is degraded is found, the bacteria from that triplicate will be streaked for isolation and identified using BioLog. The concentration of metribuzine will be analyzed by HPLC, while the byproducts of degradation will be evaluated by GC/MS.

38 - Comparison of Antibacterial Properties in Selected Plant parts of Spigelia marilandica

Sarah Crossan, Darlene Panvini

Belmont University, Nashville, TN

Spigelia marilandica, a Missouri native and Tennessee residing perennial, has been used by Native Americans for hundreds of years in the treatment of a wide array of human ailments ranging from bacterial infections and inflammation to intestinal worms. Little research has been done in order to scientifically support this plants' medicinal efficacy. This study tested the hypothesis that of the extracts of the roots, stems, and leaves of *Spigelia marilandica,* the root would be the part of the plant that would show antibacterial properties. Two gram positive bacteria, *Bacillus subtilis* and *Staphylococcus epidermidis*, and two gram negative bacteria, *Escherichia coli* and *Enterobacter aerogenes*, were chosen due to their use in previous literature and potential medicinal implications, with the gram positive bacteria expected to be more greatly inhibited. Ampicillin was used as a positive control so that if inhibition occurred, a known antibiotic would be available as a comparison of the strength of the antibacterial properties of the plant. The root was found to show antibacterial properties in two concentrations of extract and in 100% of the replicas of the four bacteria tested. This knowledge will prompt further research on the medicinal properties of this plant.

40 - Trees that Teach: Doing Science with 277 Students in Introduction to Environmental Science

Stephanie Jeffries

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Most large introductory courses in environmental science are large, lecture-style general education classes, where the instructor teaches students about this broad, interdisciplinary field. NC State's ES 100 is no exception, enrolling 200-400 students per section that meet in the on-campus cinema. A key objective, however, is for students to learn that science is our pathway to discovery. In 2018, I involved my class in a citizen science project on campus. After encountering a number of problems, I turned the experience into an experiment, engaging students to improve our methods. With the help of campus sustainability and instructional technology grants, we developed innovative teaching tools and data collection methods for an enhanced field lab to collect long-term data on 100 campus trees. Students invested when they became scientists, asking questions we could answer with our data and providing valuable information to NC State's Grounds Services about tree health. We plan to continue data collection with our classes to create a long-term data set that will help us better understand what factors impact the health of urban trees. Cross-campus collaboration with the College of Natural Resources, Sustainability, Grounds Services, and DELTA for this service-learning project helped NC State earn recognition as a Tree Campus USA from the Arbor Day Foundation.

41 - The revision of a core EEB course: experimenting with an interactive electronic textbook and a cloud based active learning platform to engage students

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A revision of the JMU Biology core curriculum began in 2015 in response to "AAAS Vision and Change in Undergraduate Biology Education." In 2018, faculty revised "Ecology and Evolution", a second-year course in the sequence. Previously, instructors had used a traditional textbook supplemented with case studies and clicker questions. While the instructional model increased student interactions and critical thinking, students spent limited time in the AAAS identified core

competency of "Biology Practice," such as mathematical modeling and developing and interpreting graphs. For years, senior assessment results showed that students fell below faculty expectations on questions related to quantitative thinking. Faculty were also interested in creating an inquiry-based learning environment in a large classroom (~96 students). To redesign this course, faculty identified Simbio's SimUText, an electronic, interactive textbook, emphasizing modeling and simulation, and Visual Classrooms (VC), a platform promoting collaborative learning and critical thinking, as tools to create this classroom environment while increasing "Biology Practice." Unlike prior versions of this class, students had to read the text, respond to questions, and take a quiz before lecture. They were encouraged to ask questions at the end of quizzes, which provided feedback to the instructor about difficulties. Instructors responded to questions and targeted areas of confusion, many of which were related to predicting outcomes of ecological models. Collaborative learning was encouraged with students working in groups on graphing exercises through VC, posting responses, responding to other posts, and then engaging in a classroom discussion. To determine if instruction was having an impact on student learning (specifically modeling and simulation), students were given an assessment. Students performed significantly better on the post- compared to the pre-assessment (34.5% change; $t(98)=-7.5$, $p=<0.00001$). Faculty continue to learn and train others on how to most effectively use SimUText and VC, and find these tools beneficial in engaging students.

42 - On Using the Freshman Biology Laboratory as an Undergraduate Research Experience

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Undergraduate biology laboratory courses have been traditionally pre-packaged laboratories. These teach students to operate equipment, make accurate measurements, and work well with numbers however, do not teach students how to take a scientific approach to an area of interest about the natural world. The intention of the discovery-based biology described here is part of the Tiny Earth Program (TE). The mission of TE is crowdsourcing antibiotic discovery from soil and giving students the opportunity to work first hand on a real-world applicable research. Today nearly 10,000 students are enrolled in some version of the course annually in 45 U.S. states and 15 countries. The Miami Dade College version of the lab is that it includes a large Hispanic majority, since Hispanics represent 72% of students at MDC. The other difference is that the MDC course is not offered exclusively to students that have manifested their interest in research. The course population is not hand-picked. Both sections – the TE and the non-TE group- fill out a survey during the first week of classes and another survey at the end of the semester. The data compiled during the Fall 2018 and Spring 2019 semesters will be compared and analyzed. The expectation is that the 2-semester project will generate data on the impact of the curricular change in the biology majors' students. It will also serve to look at the effect of a discovery-based lab on Hispanic students in STEM. To date most of the STEM research on Hispanic students has focused on predicting persistence and degree attainment but not in students' interest in and choice to major in STEM.

43 - A New Natural History Collections Curriculum in Biological Sciences Education

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Natural history collections are foundational to our knowledge of the biological world. Moreover, recent technological advances have resulted in the development of new uses for natural history collections, beyond what historical collectors and specimen curators envisioned. Rapid environmental change and habitat degradation necessitate the preservation, expansion, and data sharing capabilities of natural history collections. Educating experts to properly curate and utilize collections in research is a critical need in science education. Additionally, broadly training future scientists and physicians to appreciate the wealth of basic biological and natural history knowledge learned from exploration and natural history collections is needed in a general biology degree program. As part of an NSF-funded training scholarship program, we have developed a two-course series: (1) Curation of Collections and (2) Natural History Collections Research Design. Curation of Collections emphasizes current, appropriate museum-quality specimen curation and data management so that students receive an introduction to and hands-on experience with the high level of care and detail required to properly make and maintain preserved specimens and associated data. Natural History Collections Research Design is a discussion course based on primary literature readings that assesses the evaluation and

development of research questions on topics including taxonomy, biogeography, ecology, and global change biology. These courses were first taught in Fall 2017 and Spring 2018 and will be taught again in the upcoming academic year. The presentation will include detailed aspects of topics covered and mechanics of providing students with hands-on experiences. We will also present a summary of student evaluations of the courses and new strategies for implementing student-suggested alterations. Finally, variations on course credit-hour structure and content will be discussed based on different approaches taken among three collaborating institutions: Arkansas State University, Murray State University, and Southern Illinois University.

44 - Teaching with Wikipedia based Writing Assignments in the Organismal Biology Classroom

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Love it or hate it Wikipedia is among the most visited websites in the world and our students are using it. Wiki Education, a non-profit based in San Francisco, California, understands this and asks faculty to look at their students' relationship to Wikipedia and flip the traditional narrative: instead of simply telling students not to cite Wikipedia, ask them to write Wikipedia. Over two semesters in Fall 2016 & Fall 2018, I employed the Wiki Education platform to replace a traditional research paper in my undergraduate Plant Taxonomy course at Catawba College. Students engaged in research and writing with the goal of updating a low-quality Wikipedia article, termed a “stub”, on a particular organism. To support this project, I used the flexible curriculum designed by Wiki Education and developed additional assignments as needed. Wikipedia Expert Ian Ramjohn, and plant ecologist, joins us to discuss the Wiki Education Dashboard, as well as how training in Wikipedia community guidelines and best practices help facilitate appropriate referencing and composition of both a quality Wikipedia article and overall information and scientific literacy. Together, we will share my experience of using Wikipedia as a teaching tool, the experiences of my students, and the impact to Wikipedia and public knowledge.

45 - An inquiry-based approach to science process using web-based watershed tools

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There is general agreement among science educators that inquiry-based approaches to teaching science process leads to better learning outcomes. However, creating genuine experiences where the entire process of question formulation, identification of a reasonable prediction, development of a valid data collection method, specification of appropriate analytic approaches, and full interpretation of the data collected can be challenging. This is further complicated by the need to ensure that appropriate content is conveyed as part of the experience. The widespread availability of on-line data sets allows for some innovative approaches to creating these types of genuine experiences. In particular, the U. S. Geological Survey's Water Resources site and the WikiWatershed site from the Stroud Water Research Center provide data-rich sources of watershed information. The initial module in the Aquatic Methods course at Kennesaw State University focusing on Scientific Method was redesigned to take advantage of these resources. Using a combination of beginning of term pretests, group development of shared understanding, flipped classroom experiences, and integrated group and individual assignments, students developed a group-generated research proposal to explore how urbanization alters the hydrologic cycle in ways that can impact stream ecosystems. Following review and revision of the group proposals, students individually collected data from online sources, conducted statistical analyses, and summarized their results and conclusions. Student response to the experience was uniformly positive and performance on the learning outcomes associated with the module was also positive.

46 - Characterizing gene regulation of the Meis2 locus

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The *Meis* genes are a member of the homeobox super-family of genes that code for the production of transcription factors. Homologs of the *Meis* genes have been identified in all animals studied and

have been found to be expressed in similar patterns during the embryonic development of those animals. The products of the *Meis* genes are able to directly regulate the expression of target genes but are most well-known for functioning as cofactors, directly interacting with other transcription factors as well as DNA to facilitate transcriptional regulation. Most notably, they appear to act as co-factors of the evolutionarily well-conserved Hox proteins and have also been described as acting with other transcription factors on DNA. We have identified a novel gene linked to the *Meis2* gene (*meis2a* in zebrafish) in all vertebrates with publicly available genome date. This gene is located immediately adjacent to *Meis2* (*meis2a* in zebrafish) and is organized in an inverted convergently transcribed manner. Relatively nothing is known of this gene other than some preliminary work on its expression during development and that a mutation in the human ortholog of this gene has been associated with a rare form of anemia. We are interested in the mechanisms by which the genomic organization of these genes is so well conserved amongst vertebrates. Our hypothesis is that this may be due to them sharing one or more cis-regulatory elements. By using a comparative genomics approach we have identified several putative regulatory elements that are very well-conserved amongst all species. In examining the expression patterns of *Meis2* and its linked gene we observe overlaps which supports our hypothesis. In addition, characterization of one of the putative cis-regulatory elements suggests that it may be involved in regulating these overlapping patterns of expression.

47 - The Behavioral Effects of Delta-9-Tetrahydrocannabinol (THC) on a Spastic Mutant

Victoria Mendiola

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Hyperekplexia is a neurological disorder characterized by startle-induced bouts of spasticity caused by improper excitatory and inhibitory neurotransmitter signaling. Phenotypic expression of hyperekplexia varies in severity, and is typically onset from birth with symptoms attenuating with age in both genders. Individuals with hyperekplexia often experience hypertonia, and the pain associated with excessive and prolonged muscle contractions, which can affect morphological development. *Bandoneon* (beo), a zebrafish mutant line containing a glycine receptor β-subunit mutation, models one form of human hyperekplexia. The loss of proper glycinergic signaling alters the balance between inhibitory and excitatory signals and prevents reciprocal inhibition. The development and communication among these circuits affects the likelihood of an organism's fitness and survival. The endocannabinoid system, an essential developmental and regulatory mechanism, is present in zebrafish beginning at 24 hours post-fertilization (hpf) and contributes to neurotransmitter signaling, thus acting as a major contributor to embryonic development. A major synthetic regulator of the endocannabinoid system is Δ^9-tetrahydrocannabinol (THC), a psychoactive constituent of *Cannabis sativa*. This research aims to examine the ability of THC to reestablish proper excitatory and inhibitory signaling in the bandoneon mutant in order to facilitate coordinated movement. Through the use of behavioral assays quantifying the innate escape circuit in zebrafish, this research details the ability of THC to alleviate efferent motor malfunctions and developmental perturbations caused by startle-induced muscle spasticity.

48 - Toxicity and localization of Virus Like Particle HK97 in Danio rerio

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Virus Like Particles (VLPs) are small, self-assembling protein subunits which organize into hollow protein cages that mimic the structure of a viral capsid. These protein cages possess valuable characteristics of the native virus including immunogenic properties and a propensity for entrance into cells. However, they lack the viral genome and the ability to replicate, rendering them non-pathogenic. VLPs can be both internally and externally modified utilizing standard genetic and biochemical techniques and are being developed as a tissue-specific drug delivery system. HK97 is a well-characterized VLP derived from a bacteriophage that has yet to be tested in the zebrafish model. This study evaluates the toxicity of HK97 in its unmodified form as well as with the addition of the cell targeting peptide, RGD. Results indicate that unmodified-HK97 is non-toxic at biologically relevant doses in zebrafish, making this particle a viable option for nanomedicine and a potential small molecular delivery system to further investigate zebrafish disease models.

49 - Zebrafish, Standard Operating Procedures, and Bioinformatics: Educational and Marketable Exercises for Students Enrolled in Upper-Level Undergraduate Courses

Adam Davis

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The zebrafish (*Danio rerio*) is a widely used vertebrate model system in several branches of biological research. However, the types of wet-lab exercises involving zebrafish embryos that undergraduate students can perform during a 2-3 hour laboratory period are limited. Fortunately, recent advances in web-based bioinformatic applications and the availability of genomic sequence data from zebrafish and other evolutionarily divergent vertebrates, including human, allow students to be actively involved in semester-long molecular, evolutionary and developmental biology projects that can be performed both in and out of the laboratory. For this presentation, I will report several exercises that can be used in upper level undergraduate biology courses that include a 1-3 hour weekly laboratory session. These exercises include cDNA, amino acid and genomic DNA sequence alignment, three-dimensional protein modeling, and gene expression analysis of *Hoxa2*, a developmental regulatory gene that is highly characterized in its expression and function. Further, I will introduce the concept of using of standard operating procedures (SOPs) for training students on these techniques. The exercises presented will provide several learning outcomes for students, including the identification of conserved protein domains and *cis*-regulatory elements and how mutations to these motifs can lead to evolutionary diversity as well as the development of homeostatic imbalances in humans.

50 - Neurotrophic receptor tyrosine kinase expression in embryonic zebrafish

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Neurotrophic receptor tyrosine kinases (*Ntrks*) are a family of genes required for the survival of somatosensory neurons. In humans, there are three genes in this family: NTRK1, NTRK2, and NTRK3, each of which encodes a receptor (Trk A, Trk B, or Trk C, respectively). Activation of these genes by neurotrophins leads to promotion of a specific subset of neurons. We appreciate this as a modular model of Trk function, where expression of TrkA leads to nociceptors, expression of TrkB leads to mechanoreceptors, and expression of TrkC leads to proprioceptors. Zebrafish are an advantageous model to study these interactions in vivo during embryonic development due to their transparent embryos that are externally fertilized. The *Ntrk* genes are also found in zebrafish, but due to a genome duplication event some have two paralogous genes including *Ntrk2a*/*Ntrk2b* and *Ntrk3a*/*Ntrk3b*. Using full length probes, we have determined expression of these genes at 16.5 and 24 hours post fertilization (hpf). We observed expression of *Ntrk1* at 16.4 hpf in cranial ganglia and at 24 hpf in cranial ganglia and Rohon-Beard (RB) neurons of the spinal cord. Expression of *Ntrk2a* was seen at 16.5 and 24 hpf in trigeminal ganglia as well as RB neurons along the spinal cord. Expression of *Ntrk2b* was observed in the telencephalon at both 16.5 and 24 hpf. No expression of *Ntrk3a* or *Ntrk3b* was observed during these time points. Because these genes are essential for survival of somatosensory neurons, understanding the spatial and temporal expression patterns is critical for understanding the development of the nervous system in vertebrates.

51 - Stability Analysis of a Relic Bottomland Hardwood Forest in Southwest Arkansas.

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The forests of southwestern Arkansas are part of the Tertiary Region of the Southern Coastal Plain Ecoregion. Little botanical research has been undertaken in this important ecological area. In 2006, the authors completed an analysis of the structure and composition of the bottomland forest at the Laney Farm Reserve owned by Southern Arkansas University in Columbia County. Approximately a decade later, using the plots established in 2006, the forest was resurveyed to assess the stability of this forest community. In both surveys, the important species were *Liquidambar styraciflua*, *Nyssa sylvatica*, *Carpinus caroliniana*, several species of *Carya* and *Quercus*, and *Ilex opaca*. The tree density declined from 2006 when 408 trees/ha were noted with 336 trees/ha recorded in 2018. The basal area also showed a decline from 30.6 m^2/ha in 2006 compared to 27.2 m^2/ha in 2018. However, the diversity indices were approximately the same at both survey periods and the Bray – Curtis Coefficient of Similarity between the two surveys was 82.5 %. The current analysis may provide an

important comparison with a 1600-hectare Falcon Bottoms Natural Area which is less than 18 km from away the Laney Farm Reserve. The Arkansas Natural Heritage Commission has recently cited the Falcon Bottoms as an important ecological area. All of these sites in Columbia County compose part of the Dorcheat Bayou System which is recognized as one of the major drainage basin areas west of the Ouachita River and east of the Red River Valley.

52 - Changes in Avian Diversity and Potential Invasive Seed Dispersal Post-Wildfire in an Eastern Deciduous Forest within the Flipper Bend Woods, Signal Mountain, Tennessee

Mary Feely, David Aborn

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In Tennessee, the Flipper Bend region presents a unique opportunity to analyze habitat regrowth two years after a major, uncontrolled wildfire. This fire was an unintentional, manmade burn and invasive plants, such as *Lonicera maackii*, are thought to have increased intensity by allowing the fire to easily spread and to have created fire "ladders" into the crowns of trees. In order to examine post-fire recovery and potential invasive plant recolonization, researchers sought to observe the diversity of avians. This has not been well documented in eastern forests, especially changes in bird communities and their role in plant recolonization, and more research is needed to understand the relationship between these communities. Though the avian diversity of pre-fire conditions is unknown, we observed the post-fire effects on avian usage and whether it assisted disturbance-dependent species. Birds were surveyed using line transects and caught in mist-nets, and fecal droppings were collected to determine if viable seeds of invasive plants were being spread by ornithochory. The objectives of the master's thesis were to (1) examine the overall avian evenness and richness within the post-burned site, and (2) examine whether invasive plant species recolonization of the forest could be assisted by bird ornithochory. The first-year preliminary results will be presented.

53 - Plant species richness patterns are shaped by multiple ecological processes across space in the longleaf pine ecosystem

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Multiple ecological processes, which often operate at different spatial and temporal scales, can influence community patterns simultaneously. Thus, a key challenge for ecologists has been to identify which processes act to produce the patterns we see at different scales of observation. Here, we examined whether multiple processes operating at different spatial and temporal extents (soils, climate, species pool size) simultaneously influence plant species richness patterns in the longleaf pine (Pinus palustris) ecosystem. Specifically, we ask, 1) How does plant species richness change across the spatial extent of this ecosystem?; 2) Which ecological processes are most important in structuring those patterns? and 3) How does the relative importance of processes change across geographic regions? We assembled vegetation and soil data for 851 100 m^2 plots from high-quality, fire-maintained longleaf pine sites located in the southeastern US. Species pools for each plot were built using a two-step approach that accounted for dispersal limitation and environmental tolerance. Structural equation modeling (SEM) was used to quantify the unique variance in species richness explained by soils, climate, and species pool size for all plots and for plots in each geographic region. Soil properties collectively were the most important driver of species richness, regardless of region. Climate and species pool size explained additional variation in species richness, although substantially less. These patterns remained consistent across geographic regions, but the individual soil and climate parameters that explained the most variation in species richness changed across space. These results suggest that plant species richness in fire-maintained longleaf pine woodlands is primarily structured by soil properties, and secondarily by climate and species pool size. However, the identity and relative importance of these processes on species richness patterns were scale-dependent.

54 - Bee Diversity in Two High Quality Southern Illinois Limestone Glades

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We are exploring bee diversity and floral associations in two high-quality limestone glade communities in Southern Illinois. Bees, lepidopterans, and other floral visitors were collected via hand netting and pan traps; here we focus on bees as they were the most abundant visitors and have been prioritized for identification. We sampled three times throughout the growing season in 2018 at each site. We recorded floral associations of all hand-netted insects, plus additional associations observed in the field. Cave Creek Glade (in south central IL) and Lafarge Limestone Glade (southeastern IL) had similar bee taxon richness (66 and 56, respectively). Collections of interest from Cave Creek Glade included a new state record, *Halictus tripartitus*, a bee previously known only from west of the Mississippi River, and *Bombus pensylvanicus*, a species of conservation concern due to recent declines in more northern parts of its range. Collections of interest from Lafarge Limestone Glade included *Megachile xylocopoides*, a coastal plains species with a predominantly southeastern US distribution. The European honey bee *Apis mellifera* was not abundant at either site. At Cave Creek, all recorded floral associations (15 spp.) were native plant species, and few non-natives were seen in the site. At Lafarge, 4 of 19 floral associations involved non-native species. The taxa displaying highest connectance in a preliminary bipartite network analysis included the sweat bee subgenus *Lasioglossum* (*Dialictus*), the green sweat bee *Augochlorella aurata*, and the bumble bees *B. griseocollis* and *B. bimaculatus*. Plants with the highest connectance included *Ratibida pinnata* and *Helianthus divaricatus*.

55 - Using SERNEC Data to Plan your Next Family Road Trip

Joey Shaw, Courtney Alley, Caleb Powell, Erica Rylander, John Shelton

University of Tennessee at Chattanooga, Chattanooga, TN

Since its inception in 2015, the Southeastern Regional Network of Expertise and Collections (SERNEC) has accumulated over 4.5 million specimen records. However, few would argue that some data are biased to regions where collectors spend the most time or to taxa that collectors find most appealing. This collection bias, which results in undocumented county records, has left large gaps in our knowledge of plant species distributions and communities. Here we present the results of a data-driven, targeted effort to fill in those gaps using spatial contiguity analysis based on county resolution occurrence data from the SERNEC database. In an effort to efficiently collect county records, these data were used to identify species common to Tennessee which remain undocumented in counties between Chattanooga and Memphis, Tennessee. Using observations from the citizen science platform, iNaturalist, these commonly uncollected taxa were located along the route from Chattanooga to Memphis, Tennessee. This presentation aims to demonstrate how a family road trip, informed by SERNEC & iNaturalist can efficiently and effectively fill in knowledge gaps.

56 - Vascular Flora and Habitat Assessment of Three Wetlands in the Red River Gorge Geological Area and Clifty Wilderness in Menifee and Powell counties of Kentucky

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The Red River Gorge Geological Area and Clifty Wilderness are two gems of biodiversity in eastern Kentucky. This area is known for its arches, rock houses, and the scenic Red River. It is also home to a number of small wetlands that have not been surveyed for vascular plant diversity. Kentucky has lost over 80% of its historical wetlands, thus the documentation of remaining wetlands is pivotal for the preservation of our natural history. Furthermore, little is known about certain wetland types (e.g., upland forested wetlands) and there is little floristic data for much of the Appalachian Plateau Physiographic Province. Vascular floras of three wetlands were conducted during the 2018 growing season to better document wetland vascular plant diversity in the region and to increase the understanding of these unique habitats. This project also served to provide baseline quality data for these habitats that will allow better calibration of habitat assessment measures. This study conducted three habitat quality assessments at each wetland: the Floristic Quality Assessment (FQA), the Kentucky Wetland Rapid Assessment Method (KY-WRAM), and the Kentucky Vegetation Index of Biotic Integrity (KY-VIBI). The results of the three quality assessments were then compared to determine if there is congruence in the habitat quality suggested by the three measures. The FQA and KY-WRAM were conducted once at each site. The KY-VIBI relies on plant identification and was conducted four times throughout the growing season at each wetland to determine if there was any change in the resulting quality scores. No major change was seen in KY-VIBI scores, however one of the three wetland sites had a higher KY-WRAM when compared to FQA and KY-VIBI. Results of the

floras and habitat assessment comparisons will also be discussed including species diversity, rare and invasive species encountered in this study.

57 - Comparing the Georgia Endemic Calycanthus brockiana (Calycanthaceae) and Calycanthus floridus (Calycanthacea) using ITS and matK

Katie Horton, Abby English, Tom Diggs, Clarke Miller

University of North Georgia, Oakwood, GA

Calycanthus floridus (L.) and rare Georgia endemic *Calycanthus brockiana* (Ferry & Ferry) are two species of sweetshrub native to the eastern United States. Current literature separates these two based on a limited set of morphological characteristics. In this project we statistically compare the size and shape of the leaves, and the length and shape of the pubescence on the achenes *of C. floridus* (sensu lato) and *C. brockiana*. The results of our analyses will allow us to suggest whether the two species remain separate or be treated as one entity. Future comparisons will be completed using molecular phylogenetics.

58 - Tissue Culture and Plant Regeneration of the Endangered Schweinitz's sunflower (Helianthus schweinitzii Torr. & A. Gray)

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The objective of this study was to examine and optimize *in vitro* propagation methods of an endangered sunflower species, Schweinitz's sunflower. Excised stem segments of this sunflower were grown *in vitro* on MS nutrient media containing varying combinations of indole acetic acid, IAA (auxin) and/or benzyl amino purine, BAP (cytokinin) as growth factors. Stem-node pieces were grown on MS medium with three different concentrations of BAP: 0.1, 0.5, 1.0 ppm. The preliminary results suggest that the number of shoots increase as the level of BAP increase, with the optimal concentration of 0.5 ppm. When the stem internode pieces were placed on the MS media containing varying combinations of BAP [0, 0.1, and 0.5 ppm] and IAA [0, 0.1, and 0.5 ppm], the media with both BAP and IAA promoted the internode segments to form callus, shoot, and root. The results indicate that the media with 0.5 ppm BAP and 0.1 ppm IAA provided the maximum yield of new plantlets forming both shoot and root. Plantlets with healthy shoots and roots were transplanted into a soil mixture and kept inside a mist-box in a controlled greenhouse. After 4 weeks following the transplantation, all the transplanted plants were healthy. These results confirm that the determined optimal amount of BAP and IAA could initiate callus and plantlet growth, indicating that *in vitro* techniques are useful for the species.

59 - The Lost Flora of Tennessee; A Floristic Investigation Into the Copper Hill Basin, Polk County, Tennessee.

John Shelton, Joey Shaw

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Located in Polk County, Tennessee, in the Southern Blue Ridge Mountains ecoregion, there exists a 4,400 ha (11,000 acre) area known as the Copper Hill Basin. Massive copper mining operations occurred throughout the 1800s until about 1930, leaving the area poisoned by sulfur induced acid rain, making the area completely devoid of vegetation, and creating severe erosion problems down to mineral soil and bedrock; in fact, this area, often called the "bare zone", was frequently likened to the surface of Mars. Due in part to large efforts and investments by government agencies, like TVA, the Citizen Conservation Corps (CCC), and volunteers throughout the last 100 years, much of this area is now fully vegetated and it all began with the planting of over 16 million pine trees. Establishing a checklist of the species that occupied the site in the past is possible due to the Southeastern Regional Network of Expertise and Collections data portal. Furthermore, field trips to the site over the last two years to document the current flora of the Bare Zone have resulted in a current checklist of 403 species, across 95 families and 131 genera. While aggressive, in some cases "invasive" species were integrated into the area to slow erosion and establish vegetation in this denuded and degraded area, today only 13.39% of the flora of the site is non-native and several rare species, including: *Chelone obliqua* ssp. *erwinia*, *Calopogon tuberosus*, *Utricularia gibba*, *Vaccinium macrocarpon*, and *Cypripedium acaule*, which are now established and thriving in some localities.

60 - County Records and Major Range Extensions for Angiosperms from the Lampasas Cut Plain of the West Cross Timbers and Prairies in San Saba and Mills Counties, Texas

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As conservation ecology and plant restoration become more important due to habitat loss, a well-known flora of an area is essential for making conservation decisions and restoring ecosystems. Plants were collected along the Texas Colorado River bordering Mills and San Saba counties as well as Timberlake Biological Field Station located near Goldthwaite, Texas in June of 2018 as a project for the Tarleton State University REU program. Both Mills and San Saba counties lie close to the boundary of the Cross Timbers and prairies and Edwards Plateau ecoregions. This creates a species rich environment of vegetation characteristic of these two regions. However, few studies on the flora of this region have been conducted. The purpose of this study is to expand the knowledge of the flora of Mills and San Saba counties. Plants were categorized as endemic, native or invasive and compared to species which occur on the Texas State-listed Noxious Weeds and State threatened and/or endangered list. Eleven new county records were collected for Mills County and nine for San Saba County. Including two species, *Cynodon dactylon (*L.) Pers. in San Saba county and *Morus rubra* L. Mills county, which were major range extensions meaning they had not been collected in surrounding counties. No species occurred on either the Texas State-listed Noxious Weeds or State threatened and/or endangered species list.

61 - Diamond in the rough: Rare and interesting plants recorded in Poinsett County, Arkansas

Jennifer Reed, Travis Marsico

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Poinsett County, Arkansas, is in the north east part of the state and contains two ecoregions: the Mississippi Alluvial Plain or "Delta" and Crowley's Ridge. Although Poinsett is dominated by row-crop agriculture, it offers protected areas such as Lake Poinsett State Park and Bayou De View Wildlife Management Area, which provide a diversity of wetlands, riparian areas, and uplands, including a variety of Crowley's Ridge forest habitats and remnant prairies. Through our three field seasons we collected 2,468 specimens that at least total 604 species in 115 families. At least 230 species are county records including *Carex lupulina, Saccharum gigantea, Quercus laurifolia,* and *Epifagus virginiana*. We also found species that are tracked by the Arkansas Natural Heritage Commission including *Carex kraliana and Carex laevivaginata*. Numerous species were also regional records to either the Delta or Crowley's Ridge. Our findings demonstrate that plant collecting is still vital for providing new and informative data on distribution, range, and populations of plants, particularly those of conservation concern.

62 - Bringing a historic collection into the modern era: Curating the J. K. Underwood seed collection at the University of Tennessee Herbarium (TENN)

Nathaniel Kingsley, Chelsea Miller, Holly Brabazon, Ian Ware, Jessica Budke

University of Tennessee - Knoxville, Knoxville, TN

The University of Tennessee Herbarium (TENN) presents a case study for modernizing a historic seed collection. TENN staff recently rediscovered the J. K. Underwood Seed Collection (ca. ~ 1931-1964), containing over 700 unique specimens, hidden away in storage. We employed a series of curation actions to modernize the collection and render it useful to researchers. This included physically organizing and digitally indexing the collection, updating scientific names to current taxonomy, storing the specimens in modern archival-quality containers, housing the collection in environmentally-controlled conditions, and increasing accessibility of the collection by photographing specimens and integrating these images into our existing website (tenn.bio.utk.edu). Our efforts also included developing a protocol for adding new accessions to the collection and advertising the utility of the collection as a source of morphological data on seeds for identification, research, and teaching. We also review modern strategies for curating seed collections. Specifically, we emphasize the importance of increasing visibility of collections through visual, digital representations. This expands the utility of collections and fosters global information sharing across disciplines. We present our curation project as a case study that can serve as a model for curating historic seed collections.

63 - The paraventricular thalamic nucleus is necessary for melatonin-dependent seasonal changes in immunity and glucocorticoid secretion in Siberian hamsters

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Siberian hamsters (*Phodopus sungorus*) exhibit robust seasonal rhythms in immune function and stress responsiveness. The environmental cue driving these seasonal adjustments is photoperiod, which is encoded endogenously by the duration of rhythmic pineal melatonin (Mel) secretion. The central neuroendocrine targets mediating Mel-dependent regulation of stress responsiveness and immune function remain unspecified. There are multiple neural Mel targets in Siberian hamsters, including the suprachiasmatic nucleus (SCN), the nucleus reuniens (NRe), and the paraventricular nucleus of the thalamus (PVt). The PVt is of particular interest with regard to stress and immunity as it has been implicated in the neural regulation of the stress response. To address the role of the PVt in seasonal alterations of these measures, male Siberian hamsters underwent PVt ablation or sham ablation. Animals from each group were then exposed to either short- or long-day light cycles. On Week 5 post-ablation, blood samples were collected and used to perform a white blood cell (WBC) count and differential, and a bactericidal capacity assay. On Week 7, animals were exposed to a restraint stress test, during which blood samples were collected and used to perform a WBC count and differential, and a cortisol ELISA. Results indicate that the PVt is necessary for the expression of the short-day bactericidal phenotype. PVt status impacted WBC differential, as well as the levels and patterns of cortisol expression. These findings establish the PVt in mediating seasonal regulation of both immunity and stress responsiveness, thus clarifying the mechanisms by which environmental cues alter physiology and behavior.

64 - Scaring the silk out of spiders: The use of defensive silk in response to predatory and non-predatory stimuli in the western widow spider (Latrodectus hesperus).

Alphie Rotinsulu, Aaron Corbit

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The western widow spider (*Latrodectus hesperus*) is known to modulate its defensive behavior based on perceived level of threat, utilizing more costly and risky behaviors (like biting and venom use) as the perceived threat increases. One, little studied, aspect of this spider's defensive behavior is the use of defensive silk. This unique silk is comprised of large sticky droplets attached to a central thread. When threatened, these spiders actively try to place this silk on the potential threat. Preliminary evidence suggests that *L. hesperus* can modulate many aspects of defensive silk use, including the time to initial release, the volume produced, and the rate at which it engages in silk-releasing behavior. We examined whether *L. hesperus* can distinguish between threatening and non-threatening biological stimuli and modulate its defensive silk use accordingly. Using a repeated measures design, we exposed spiders to five different stimuli. These included dried specimens of a known predator of widow spiders - the Blue Mud Dauber wasp (*Chalybion californicum*), dried house crickets (*Acheta domesticus*), recently frozen house crickets, recently frozen predatory wasps (including *Polistes sp.*, *Specidae sp.*, *Dolichovespula arenaria*, *Scolia dubia*) and a non-biological control. We found evidence that these spiders release defensive silk more quickly when exposed to the recently frozen crickets and frozen wasps than the non-biological control. This suggest these spiders have the ability to distinguish between different biological stimuli and modulate their defensive behavior accordingly.

65 - The Efficacy of Bait-Trap Methods in Butterfly Monitoring in an Urban Park in Nashville, Tennessee

Marcie Bulla, Darlene Panvini

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As urbanization expands, monitoring populations of indicator species in and around cities is increasingly important to assess the impact that civilization has on the environment of remaining green spaces. As a pollinator with particular sensitivity to environmental disturbances, butterflies are one potential indicator species. However, most standardized butterfly baiting protocols are written for tropical and neotropical regions to attract fruit-feeding butterflies and do not offer direct guidance for bait-trapping methods in other regions of the world. This study assessed the efficacy of banana and

nectar bait trap protocols in wooded and open field areas in an urban park in Nashville, Tennessee to determine if bait-trapping is a viable method for butterfly monitoring in this region. Results indicated that banana baited traps can be used as a baiting method for the family *Nymphalidae* only, and that future studies must maximize the diversity of habitats studied. Commercial nectar traps were found to be ineffective in attracting all types of butterflies. These results could serve as a guide for improving butterfly baiting methods in temperate regions of North America in order to facilitate the analysis of butterfly populations in other cities throughout the region, although further research is needed to determine if a trapping method exists for families outside of *Nymphalidae*.

66 - Temperature effects on species interactions in green frog tadpoles

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Predation and competition often interact to affect individual growth and survivorship of prey species. Temperature is an abiotic factor that can regulate species interactions including the nonconsumptive effects of predators and competition. In this study, we examined the behavioral and developmental responses of green frog tadpoles (*Lithobates clamitans*) to the interactive effects of temperature, conspecific density, and water-borne predator chemical cues (dragonfly larvae, *Macromia illinoiensis*) in a split-plot experiment. We predicted that tadpoles in warmer water at lower density would grow and develop faster than those in colder water at higher density, that predator cues would lead to deeper tail fins and be lower activity compared to no cue treatments, and those in no predator treatments. Behavioral trials revealed that tadpoles moved and foraged less in the presence of nonconsumptive predators. However, lower activity levels did not slow growth. Lower temperatures did slow tadpole growth, but there was no evidence of an interaction with nonconsumptive predators or competition. Performance trials revealed no difference in survivorship among treatments. The combination of temperature variation and predators will likely alter tadpole growth development.

67 - Anthropogenic Sound in the Sea: Are Ascidians Affected?

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Sound pollution in the marine environment has been increasing largely due to anthropogenic sources such as boat motors, pile driving, oil drilling, and sonar. Studies determining the impacts of anthropogenic sound on marine organisms have mostly focused on vertebrates, namely fish and marine mammals; however, less research has been done to study the effects of sound on marine invertebrates. The goal of this research is to examine the impact of anthropogenic sound on the ascidian *Styela plicata* (Lesueur, 1823). A total of 40 ascidians were collected from two separate sites in Tampa Bay with differing amounts of boat traffic and thus anthropogenic soundscapes. Ascidians were individually exposed to three separate stimuli: a recording of a boat motor, a song, and an aquarium pump to simulate turbulence. Ascidian reactions were recorded as the frequency of siphon closing events and the length of time the ascidian remained closed after disturbance. Results suggest the ascidians from both sites reacted similarly to each other, yet there were significant differences between experimental and control specimen reactions based on frequency and longevity of siphon closing in both populations.

68 - Factors Affecting Phonoresponse in Virgin Females of Syntomeida epilais (Lepidoptera: Erebidae, Arctiinae, Euchromina)

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Acoustic interactions between eared moths and insectivorous bats have been well documented. Many tiger moths answer bat echolocation calls using tymbals. Most commonly, these moths have been stimulated with bat calls while restrained (either tethered or held by the wings, i.e., their legs are not in contact with the substrate). Some of these moth species also use acoustic communication during their mating behavior. *Syntomeida epilais* is one of few species in which both genders emit acoustic signals (modulation cycles) during mating behavior. Our aim was to determine whether females could distinguish between bat and conspecific calls and whether restraint made a difference. We stimulated 9 virgin females of this species with playback of a male signal with 12 MC and a bat

attack sequence (38 pulses), both with similar duration (1.1 s). Each of these series was applied 3 times at intensities between 56 and 95 dB SPL. Each female was stimulated while free (perched) and restrained (held by the wings). Free moths phonoresponded to 99% of the male series. When restrained they responded to only 4% of this series. Under each of the recording conditions these females phonoresponded to more than 80% of the bat sequence applied. Our results are consistent with the idea that these females in flight (tarsi not in contact with the substrate, simulated by restraint) respond best to bat calls. When perched, as they are in courtship, they respond best to their male conspecific calls.

69 - The role of nitric oxide in memory formation of the dwarf cuttlefish, Sepia bandensis

Jessica Bowers, John Wilson, Dragos Amarie, Vinoth Sittaramane

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Long term memory (LTM) is the ability to retain learned information for several hours up to a lifetime. Nitric oxide (NO) has emerged as an important new player in LTM formation. Inhibited NO synthesis disrupts learning in simple invertebrate model systems such as *Aplysia,* and recent work has also implicated NO in memory formation of cephalopods. Cephalopods offer the unique opportunity to study the role of NO in a complex invertebrate system, allowing for comparative analyses with vertebrates. Our project uses behavioral and neural approaches to investigate the role of NO in memory of the dwarf cuttlefish, *Sepia bandensis.* For our behavioral approach, cuttlefish will be injected with L-NAME, an NO synthesis inhibitor, then trained to complete a simple memory task optimized in previous work. After training, L-NAME cuttlefish and controls will be exposed to a single retention test. This will determine whether NO inhibition during training affects LTM of the task. Lastly, the Greiss spectrophotometric assay will be conducted to confirm whether NO concentrations are reduced in L-NAME treated tissues. The functional pathway and neural targets of NO are poorly known. The LTM-related transcription factor, CREB, is a useful marker for learning in simple molluscan systems, and is a potential target of NO. Our neural approach aims to determine whether NO inhibition affects the presence of CREB in cholinergic neurons, the site of LTM in cuttlefish. Brain, arm, and tentacle tissues will be double stained and imaged via confocal microscopy. Cholinergic neurons will be identified with conjugated alpha-bungarotoxin, which binds to acetylcholine receptors. CREB will be immunolabeled with primary and secondary antibodies. The number of CREB-positive cholinergic neurons will be counted in L-NAME treated cuttlefish and controls to determine whether NO participates in LTM-related CREB activation.

70 - Wild Hog (Sus scrofa) Preference among Planted Pine and Hardwood Seedlings and the Ecological Factors Influencing Young Forest Plantation Damage

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Across the southern United States, the expanding range of wild pigs (*Sus scrofa*) has the potential to hinder longleaf pine (*Pinus palustris* Mill.) restoration efforts. The depredation of planted pine seedlings is the most widespread and economically costly damage by wild pigs to young forest plantations. By understanding the ecological factors driving depredation rates and characteristics, better management practices can be created to reduce mortality from wild hogs while seedlings are in a vulnerable stage of growth. From March 2016 to March 2017, two sites in Alabama were used to test if wild hogs had a preference between planted pine and hardwood species. Damage was not equally distributed among the five seedling species tested and results suggest that longleaf and cherrybark oak were the most highly preferred. Nearly all of the seedlings destroyed by wild hogs were from the cutover site which experienced substantially more hunting pressure compared to the other site. A variety of reasons could be used to explain this phenomenon but it is thought that the debris scattering practice of the logging crew following a clear cut created a desirable foraging environment that led to the initial discovery of the seedlings. The short-term protection and minimization of seedling depredation in young forest plantations is the most realistic solution to reducing the impact of wild hogs on forestry and timber resources.

71 - Natural tissue concentrations in adult Ambystoma maculatum and larval DNA damage from exposure to arsenic and chromium

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Arsenic (As) and chromium (Cr) are two contaminants that are detected in aquatic and terrestrial habitats. Using the spotted salamander, *Ambystoma maculatum*, to assess impacts from these contaminants may be advantageous as adults live and breed in such environments. Adult amphibians typically exhibit elevated tissue concentrations of contaminants present in their environment, while larval stages were found to exhibit increased sensitivity to pollutants. From January through March of 2015, during the spring breeding season, 5 adults and approximately 32 egg masses were collected from a local breeding site. Field levels of As and Cr ranged from 5.99 to 8.88 µg/L and 1.45 to 2 µg/L, respectively, while mean adult As tissue concentrations were 56.74 µg/g dry weight for heart, 0.92 µg/g for liver, and 1.21 µg/g for tail tissue. Mean tissue concentrations for Cr were 87.64 µg/g for heart, 1.47 µg/g for liver, and 6.92 µg/g for tail. Developing larvae that were collected from the field and exposed in a lab setting for 12 d to 0.2 or 20 mg/L of either As or Cr displayed little DNA damage attributed to As, but marked damage due to exposure to 20 mg/L Cr when assessed using the comet assay. Exposure to a mixture of either 0.25:0.1 or 25:10 mg/L As and Cr resulted in significant DNA damage at the lower concentration of 0.25:0.1 mg/L. As adult spotted salamanders were found to possess high concentrations of these contaminants in cardiac tissue, and larvae were shown to be susceptible to DNA damage from increased exposures, assessing impacts and potential declines of amphibian populations exposed to As and Cr is needed.

72 - Maternal Effects in Response to Mycoplasma gallisepticum Infection in Eastern Bluebirds

Sarah Amonett, Susan Balenger

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Neonates lack adaptive immunity and are vulnerable to pathogens. Mothers can potentially alleviate the costs associated with infection by transferring passive immunity to offspring via maternal antibodies (Abs) passed through yolk. Mothers previously or currently infected with a pathogen may transfer Abs to newborns, granting them immunological protection until they can synthesize their own. In birds, Abs are deposited before eggshell formation within the mother's oviduct. It was recently found that wild eastern bluebirds (*Sialia sialis*) are common hosts of the avian pathogen *Mycoplasma gallisepticum* (MG). In 2018, 59% of wild adult eastern bluebirds in Mississippi tested positive for MG Abs. We also sampled 126 nestlings and found 8.7% of nestlings were positive for maternal MG Abs. In our preliminary analyses, maternal immune status is not related to hatching success or nestling growth rate, and more data is needed to understand if nestling immune status is related to nestling quality or growth. Similarly, mothers may transmit pathogens that colonize the oviduct. MG itself is known to be vertically transmitted in poultry, and it colonizes the oviducts of infected hens and is transmitted to embryos during egg formation. I am investigating the possibility of vertical MG transmission in our population of eastern bluebirds. If vertical transmission of MG is occurring, then maternal Abs could provide critical immunological support to embryos exposed during development. This study provides insight into non-genetic, maternal effects on offspring survival and growth in response to a costly infection.

73 - Nest microclimate influences physiology and development in the eastern bluebird (Sialia sialis)

Brooke Sykes, Susan Balenger

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Selective pressures produced by climate variability have led to differential thermal tolerances amongst animal species. Endothermic animals expend large amounts of energy maintaining their body temperature, and the critical temperatures (maximum highs and minimum lows) that they are able to tolerate depend largely upon the geographic range that they evolved in. When temperatures become unfavorable, adaptations that allow organisms to respond plastically provide an advantage. Those unable to physically migrate must deal with elevated heat metabolically. Altricial nestling birds, which are born naked and unfeathered, cannot maintain their own body temperature until their

feathers grow in, and are essentially ectothermic in the early stages of their development. While in the nest, their growth, body condition, and immune response are directly linked to the microclimate in which they are raised. Factors that disrupt their development, then, can be costly. By experimentally manipulating the temperature of nest boxes, I am quantifying a response to heat in eastern bluebird (*Sialia sialis)* nestlings using heat-shock protein 70 as a biomarker for physiological stress. Heat-shock protein 70 is constitutively expressed at baseline levels, but is upregulated under high temperatures. The effects of high HSP70 levels are not known, but there are implications for reduced lifespan and changes in immune effects in other organisms. I am also measuring changes in body condition as well as differing loads of a parasitic bacteria that degrades feathers and thrives under a temperature optimum. Parasites often impose a cost to physical condition, so any observed changes in growth rate under heat must also be examined in relation to parasite load. I found that feather-degrading bacterial load did not differ between treated and untreated nests, but that heated birds exhibited poorer body condition over the course of their development as well as decreased growth rate.

74 - Response to rapid habitat perturbation in the slider turtle (Trachemys scripta): Behavioral and hormonal effects.

WB Cash

University of Central Arkansas, Conway, AR

The condition of resources in ecological systems is inherently stochastic and the physiology and activity patterns of organisms reflect this. Reptiles show an increased concentration of corticosterone in response to an array of stressors, both acute and chronic. The effects of corticosterone release have been linked to a number of important functions, both physiological and behavioral. A slider turtle population in north Mississippi experienced a rapid habitat perturbation when a dam failed on an artificial pond (Pond A). A significant number of turtles were previously marked in Pond A and surrounding ponds (n = 5; Ponds B–E) enabling potential recapture. From August through October 1997, turtles from Pond A were recaptured in all of the surrounding ponds. Thirty-three males and 11 female emigrants from Pond A were recaptured. Blood samples were obtained for all emigrants (E) and compared to known resident (R) populations for analysis of corticosterone, estradiol and testosterone concentrations. For all hormones measured, blood samples were obtained at time of capture (T0). Blood samples were also taken at 30 min and 60 min to complete a corticosterone stress profile. Pond A emigrants had significantly higher initial corticosterone when compared to resident turtles ($Time0_E$=12.55 ng/mL ± 2.08SE vs. Time 0_R=0.705 ng/mL ± 0.098SE; P = 0.003). Pond A male emigrants had significantly lower testosterone than residents (T_E=1649.0 pg/mL ± 193.9SE vs. T_R=7123.6 pg/mL ± 882.5SE; P = 0.001). Pond A female emigrants had significantly lower estradiol than residents ($E2_E$=106.5 pg/mL ± 28.1SE vs. $E2_R$=288.7 pg/mL ± 49.6SE; P = 0.01). Importantly, the timing of the perturbation was at the height of hormonal activity and gonadal recrudescence in these populations. Observations such as these are important when considering behavioral and physiological mechanisms involved in a turtle's response to changing habitat quality and their implications to conservation.

75 - The effects of field capture and laboratory management techniques on plasma corticosterone concentrations in the slider turtle (Trachemys scripta).

Alex Ano, Lori Monday, WB Cash

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In reptiles, plasma corticosterone concentrations are affected by handling the organism or holding the organism in captivity. Questions of the effect of these procedures on the hypothalamo-pituitary-adrenal axis, and subsequently on other physiological and behavioral measures, are appropriate to insure handling or holding individuals in the laboratory does not negatively affect the outcome of investigations. Our study was conducted to determine if trapping or laboratory techniques affects plasma corticosterone concentrations in the slider turtle. Turtles for the trials were initially captured in 3-ring, baited hoop nets in Faulkner County, AR in 2014-2015. Blood samples were taken at first capture representing a corticosterone stress profile at Time-0 min (T0), Time-30 min (T30) and Time-60 min (T60). Turtles were then the assigned to a trap restraint group (n=11; 6 females, 5 males) and individually placed back into separate partially submerged 3-ring hoop nets with the funnel closed to prevent escaping for 26-30 hours when a second stress profile was obtained from all turtles. Another laboratory trial group (n=12; 4 females, 8 males) was placed in individual containers for a 36 h

acclimation period. Experimental turtles were then handled for one minute, while control group turtles were not disturbed. One hour after handling the experimental group, a corticosterone stress profile was obtained. There was a significant increase in corticosterone concentration from T0 (0.41ng/mL±0.10SE) to T30 (3.48ng/mL±0.91SE) during the initial stress series for the individuals sampled (P<0.0001). A two-way RM-ANOVA with factors for treatment (Field held and Lab held) and the repeated element of time revealed a significant effect of time (P<0.0001), but no significant difference between treatments (P=0.95) or the time x treatment interaction (P=0.60; T0 Field=0.66ng/mL±0.17SE; T0 Lab=0.57ng/mL±0.16SE; and T30 Field=2.58 ng/mL±0.48SE; T30 Lab=3.26ng/mL±0.97SE). Our results show that slider turtle corticosterone is not affected by these basic field and laboratory techniques.

76 - Variation in Nickel Tolerance and Accumulation in Populations of Odontarrhena serpyllifolia (Brassicaceae: Alysseae) from the Iberian Peninsula

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Odontarrhena serpyllifolia (= *Alyssum serpyllifolium*) occurs in the Iberian Peninsula and adjacent areas on various soils including limestone and serpentine (ultramafic) substrates. Populations from serpentine are known to hyperaccumulate nickel, and have been proposed as separate subspecies or species. To clarify patterns of variation among these populations, 3 serpentine accessions and 3 limestone accessions were cultivated hydroponically, alongside plants from two reference species: *Clypeola jonthlaspi* and *Alyssum montanum*. Concentrations of $NiSO_4$ from 10 to 300 µM were employed as treatments in otherwise uniform nutrient solutions. After 8 wk, plants were measured for shoot mass, root mass, and both foliar and root concentrations of Ni, Ca, Mg, K, and Fe. Serpentine accessions of *O. serpyllifolia* demonstrated high Ni tolerance; some accessions showed no reduction in root or shoot mass up to 300 µM Ni. Limestone accessions were less tolerant; however, there was a continuous spectrum of response and the least tolerant serpentine accessions were not significantly different from the most tolerant limestone accessions. Serpentine accessions maintained relatively constant tissue concentrations of Ca, Mg, K, and Fe compared to limestone accessions, which fluctuated widely in response to Ni toxicity. *Clypeola jonthlaspi* responded similarly to the limestone accessions of *O. serpyllifolia*, whereas *Alyssum montanum* had much lower Ni tolerance. Hyperaccumulation of Ni, (foliar Ni concentrations >0.1%), occurred in all accessions of *O. serpyllifolia*, but the higher Ni tolerance of serpentine accessions allowed them to hyperaccumulate more strongly. Again, *C. jonthlaspi* showed responses similar to limestone accessions of *O. serpyllifolia*, whereas *A. montanum* had much lower foliar concentrations, exceeding 0.1% only in plants showing severe Ni toxicity, which does not constitute true hyperaccumulation. The continuous spectrum of tolerance and hyperaccumulation does not support segregation of serpentine populations of *O. serpyllifolia* as distinct species.

77 - Prey Size Variation Influences Fat Storage, Vitellogenesis, and Offspring Size Among Populations of Water Snakes

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This study examines if differences in the extent of fat allocation to developing follicles explains observed variation in offspring size among four populations of watersnakes with access to different sized prey. Environmental variation in prey size likely changes energy allocation patterns by differing caloric intake. Animals using stored resources to invest in reproduction should change fat storage and subsequent fat mobilization during vitellogenesis as caloric intake is altered. Using Soxhlet extraction, we measured the extent of fat storage and mobilization among populations by determining differences in fat body mass, percent liver fat, and percent ovary fat of sexually mature snakes across the reproductive season. Fat allocation to reproduction was separated between individual follicle fat content and total fat allocation to ovaries. Increased fat allocation to ovarian follicles reflects larger resultant offspring size, whereas total percent fat to the ovary reflects overall reproductive investment. We determined differences in the extent of fat storage and mobilization using an analysis of covariance (ANCOVA) with female body mass as a covariate. Percent fat body mass, percent liver fat and percent ovary fat were analyzed independently pre-, mid-, post- vitellogenesis. Females from populations with access to larger mean prey sizes (LARGE) produced significantly longer, heavier offspring (23% heavier, 4.5% longer) than populations with access to smaller average prey sizes

(SMALL). Percent fat body mass significantly differed mid- and post- vitellogenesis between LARGE and SMALL populations. Larger average prey size allowed females to store more fat body mass at LARGE populations. Fat allocation to the ovaries, collectively and to each follicle, more accurately reflect the extent of vitellogenesis, as ovaries are final targets of this fat. Data collection of ovary fat content is underway. This study provides a potential physiology mechanism that links environmental variation of prey size with differences in reproduction in capitalist-breeding predators.

78 - Analysis of Thrombin- Treated GerE on Binding to cot Promoters that are Repressed during Sporulation in Bacillus subtilis

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Bacillus subtilis is a gram-positive aerobic bacterium that, when placed under environmental stress, possesses the ability to undergo endospore formation. This bacterium regulates sporulation through transcription control. The DNA binding protein GerE appears to regulate transcription in the late stages of sporulation and activates *sigK* associated transcription. GerE has been known to also repress the transcription of the sigma K-dependent genes including *sigK, cotA, cotE* and *cotH*. The focus in this study is to determine if the GerE, will bind to these promoter sites and ultimately repress transcription. We hypothesized that the promoter regions possess GerE binding sites, and when bound, repress transcription. We have shown that GerE can bind to the *sigK* promoter through the use of Electrophoretic Mobility Shift Assay (EMSA); however, we have not been able to show binding to other GerE-activated promoters (*cotC* and *cotX*). We cloned *gerE* in a pET-28 plasmid for over expression, which includes a 6-Histidine tag for simplicity of purification. However, an excess extension of 6-Histidine tag is formed when GerE is expressed in *Escherichia coli*. This 6-Histidine tag may prevent GerE from binding to the promoter DNA. Using thrombin, the excess 6-Histidine tag can be cleaved from the rest of the protein in the effort to allow the native structure of GerE to form. The purpose of this experiment is to distinctly show that if the 6-Histidine tag of recombinant GerE is removed by the use of thrombin, then GerE should be able to bind to the promoter DNA, in turn, allowing for the repression of transcription during sporulation.

79 - Investigating the Possible Correlation Between Microplastic Abundance and the Presence of Escherichia coli in the Cumberland River.

Chandler Phelps, Matthew Heard

Belmont University, Nashville, TN

Recent research has suggested that microplastic pollution can facilitate the growth of bacteria. However, little work been done to examine if this is occurring in ecosystems that are polluted with microplastics. To examine this, we conducted an observational study in the Cumberland River in Nashville, TN to determine if microplastic abundance was correlated with the abundance of a common bacteria - *Escherichia coli*. We also conducted an experimental study to examine how the abundance of microplastics influenced the growth of *Escherichia coli* colonies collected from the river. For the observational study, we found no significant correlations between microplastic and bacteria abundance. However, using the experimental approach, we determined that there was a significant positive correlation between microplastic abundance and bacterial growth. Our findings indicate that increasing levels of microplastics could increase the abundance of bacteria. However, more work is needed to fully understand this issue.

80 - Isolation and Characterization of Exiguobacterium: An Antibiotic Producing Organism

Magnolia Valdez, Eric Warrick

State College of Florida, Bradenton, FL

Antibiotic resistance is becoming a real problem in the world of microbiology. As part of my curriculum in the Tiny Earth Initiative, I collected soil samples from Indian beach in Sarasota, Florida in search of bacteria with antimicrobial properties. I was able to isolate a bacteria from the genus *Staphylococcus epidermidis* class bacilli, a halotolerant organism, that produced a wide zone of inhibition with *Staphylococcus epidermidis*. Using an R2A media after a serial dilution of the initial soil sample, I used patch plating to observe for antimicrobial activity around established colonies testing against *Staphylococcus epidermidis*. There was a slight inhibition zone observed with this organism which

prompted further testing. A chemical extraction that was done using ethyl acetate to extract compound(s) from the bacterium yielded a large zone of inhibition. PCR using the 63F/1387R primers amplified the *16s rRNA* in order to determine phylogenetic relationship with established organisms using the nucleotide BLAST database from NCBI. This oral presentation will go over the continued research into this organism and the results of different polar solvents.

81 - The Isolation and Identification of Antibiotic Producing Streptomyces

Morgan Dettmer, Eric Warrick

State College of Florida, Bradenton, FL

Patients are not being able to clear infections with antibiotics that once were effective resulting in a public health crisis. Major pharmaceutical companies are no longer focusing on developing new antibiotics, leaving the question what can be done about the growing threat of antibiotic resistance? Tiny Earth is research program that provides undergraduate students with protocols for isolating and identifying antibiotic producing bacteria from their local environments around the world. Since about 80% of our current antibiotics come from soil, the Gulf Coast of Mexico is a unique and untouched setting for unearthing antibiotic producing bacteria. Using the procedures laid out in the Tiny Earth Student Research Manual, soil was isolated from a bank of the Palma Sola Bay in Bradenton, Florida. The soil sample underwent a series of serial dilutions before being plated onto R2A agar supplemented with 4% NaCl. Next, the bacteria were patched plated and challenged against a Gram positive, *Staphylococcus epidermis*, and a Gram negative, *Escherichia coli*, bacteria. Of the twenty-four bacteria samples that were plated, one isolate showed antimicrobial activity against *Staphylococcus epidermis* as evidenced by a clearing zone around the isolate where *Staphylococcus epidermis* was unbale to grow. The isolate was then streaked out on another plate of R2A agar for a pure colony isolation. DNA was extracted by a boil method. Next, the *16S rRNA* gene was amplified through a polymerase chain reaction and verified through gel electrophoresis. The antimicrobial compound was extracted from the isolate, dried, resuspended in ethyl acetate, a mid-polar solvent, and again tested for antimicrobial activity. Nucleotide sequencing, preformed through The National Institute of Health BLAST search, returned a 99% match to the Streptomyces genus.

82 - Identification of gram-positive bacterial species in expressed human breast milk: effects of re-refrigeration on safety for reuse

Cortni Troublefield, Cynthia Ryder, Kathryn Gill

Midway University, Midway, KY

Breast milk has been known to provide a range of health benefits to infants including an abundance of nutritional, immunological, and anti-inflammatory benefits for the infant as well as lowering the risk of numerous health problems. When breastfeeding is not possible, mothers have the option of expressing breast milk for themselves or a child care provider to store for later use for feeding their infant. In the state of Kentucky, it is recommended that breast milk be discarded after being left out at room temperature for 1 hour and in addition, there are regulations in place that prevent child care providers from reusing or returning unused breast milk in containers that have been used to feed the child. This study focused on identification of gram-positive bacterial species found in donated breast milk samples before feeding, immediately after feeding, after 1 hour at room temperature, and after 3 hours of refrigeration with the objective of examining the safety of reusing expressed breast milk. Eleven bacterial strains were identified from the genera *Bacillus, Lactobacillus, Brevibacillus, Streptococcus,* and *Staphylococcus* and it was found that there was no greater variety of gram-positive bacterial species present after feeding compared to before feeding. However, refrigeration was associated with a decrease in the number of species found compared to after feeding. The identified species included both commensal organisms and known human pathogens.

83 - Antimicrobial Properties of Soil Microorganisms Underneath Exotic and Native Plant Species in Nashville, Tennessee

Britney Sams, Adria Payne, Jennifer Thomas, Darlene Panvini

Belmont University, Nashville, TN

Within the last century, humans have discovered antibiotics, exploited their properties, and now entered into a period where their efficacy is waning. Many pharmaceutical companies have ceased their efforts in antibiotic research due to the high adaptability that bacterial species have to become resistant to medications and the high costs associated with antibiotic research and development. This project adapts principles and procedures established by the Small World Initiative to explore soil bacteria in Nashville, Tennessee for potential antimicrobial characteristics. The introduction of exotic plants into areas can be a conduit for novel bacteria to grow and thrive in new environments. Therefore, a group of thirty bacterial unknowns were collected from soil found beneath a native and an exotic plant species and assessed for antibiotic properties against two gram-positive bacteria, *Bacillus subtilis* and *Staphylococcus epidermidis,* and two gram-negative bacteria, *Escherichia coli* and *Enterobacter aerogenes*. Three of thirty bacterial unknowns were found to exhibit zones of inhibition when cultured on bacterial lawns of *Staphylococcus epidermidis*. The use of sterile disks to test for antagonistic properties of soil bacteria is an easily used biological technique that can be used in future antibiotic research and development projects.

84 - An Examination of Undergraduate Students' Plant Blindness and Botanical Literacy

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Plant blindness is the inability to notice plants in an environment, which can lead to the misguided view that plants are not important (Wandersee & Schussler, 2001). Wandersee and Schussler (1999) have defined four components that contribute to plant blindness: attitude, attention, knowledge, and relative interest. Botanical literacy, a subset of scientific literacy, is exhibited by students when they are able to apply knowledge to make scientifically sound decisions regarding socioscientific issues (SSIs) like food ethics, climate change, and plant conservation. Valid and reliable measures of plant blindness and botanical literacy currently do not exist, so we have developed and piloted two instruments: the Plant Blindness Index (PBI) which measures all four aspects of plant blindness, and the Botanical Literacy Inventory (BLI) which is a concept inventory. We piloted these instruments in a pre-post model with students in a required undergraduate botany course at a small liberal arts college in the Midwest. We found that students had significantly higher scores on the PBI, BLI, attention, and knowledge subscales ($p < 0.05$). In the second semester we repeated this process and found that students had significantly higher BLI, PBI, attention, knowledge, and relative interest scores ($p < 0.05$). Students also completed a causal map activity at the beginning and end of the semester. A causal map is similar to a concept map but indicates cause and effect relationships. We developed a rubric to evaluate these maps, and examined students' use of human links as a measure of student knowledge of human relationships and as a connection to botanical SSIs. We identified students from a range of plant blindness scores and invited them to interviews which explored reasons behind student levels of plant blindness and botanical literacy. More detailed information on the qualitative data from interviews and causal maps will be presented.

85 - LABS: A New Student Fellowship Program to Enhance Undergraduate Research Opportunities at Franciscan Missionaries of Our Lady University (Fran U)

Dawn Simms

FMOL University (FranU), Baton Rouge, LA

As part of a multifaceted approach to enhance undergraduate research (UR) opportunities and student engagement at Franciscan Missionaries of Our Lady University (Fran U), the Laboratory Assistant Biology Stipend (LABS) program was implemented in the Fall 2018 semester. Fran U (formerly Our Lady of the Lake College) is a young university; as such, it is imperative that efforts to support student engagement, research, and academic scholarship are prioritized, as these are the benchmarks of highly ranked universities. Recent NSSE (National Survey of Student Engagement) data has shown a significant deficit in quantitative reasoning among senior students, as well as a lack of supportive environment (e.g., providing support to help students succeed academically). The LABS program provides faculty mentorship with particular emphasis on significant student/faculty interactions outside of the classroom, creating an infrastructure to support research and scholarly activity, developing undergraduate research projects in several biological disciplines, and stipends for students who complete research outside of coursework. LABS students have increased interaction with faculty mentors and fellow students, learn a variety of scientific concepts in a real world

environment, use advanced laboratory equipment, and participate in undergraduate research projects with the opportunity to publish or present their work in local, regional, or national venues. The goals of this presentation are to discuss the implementation, early outcomes, and engagement impacts of this new stipend program and to outline how this program helps to enhance the UR opportunities at Fran U.

86 - Success and retention model for biology and computer science majors in Two-year colleges

Loretta Ovueraye

Miami Dade College, Miami, FL

STEM-Mia ("my STEM") is a National Science Foundation funded project that provides scholarships and supports to academically talented, low-income STEM students at MDC InterAmerican Campus. Over a five-year period, the NSF - S-STEM funds will support 45 MDC students with scholarships and wrap around services toward preparing them for Science, Technology, Mathematics and Engineering (STEM) careers, which are in high-demand and critical to building a competitive workforce that will help grow America's economy. The grant project will target two primary populations – biology and computer science majors. This presentation will discuss the impact of embedding faculty mentoring, discipline immersions, self-analysis, financial support, toward fostering shaping student perceptions of their personal agency and empowering them to achieve their STEM-related academic and professional goals by helping them connect with the sources of their STEM self-efficacy and identity. What we are accomplishing in MDC serves as a model for two-year colleges seeking to incorporate curricular changes focused on success and retention in biology and computer science majors for populations who are underrepresented in STEM fields in general.

87 - Building Success in Course-embedded Undergraduate Research Experiences

Michael Renfroe

James Madison University, Harrisonburg, VA

Introducing embedded research into undergraduate courses can be daunting for both instructor and students. At JMU, an upper level undergraduate lecture/laboratory course with defined laboratory activities was transformed into a course with open-ended research projects designed by the students. Problem areas for students included mastery of scientific literature, development of detailed protocols, mathematical calculations and time management. Evaluations at the end of the semester identified challenges and concerns for the students which were then addressed in the second iteration of the course. Evaluations also revealed positive outcomes including student increases in confidence in designing and executing experiments, and higher confidence levels in technical writing skills and quantitative skills. With iterative skill building and more incremental training, students build confidence and can successfully navigate novel scientific inquiry and experimentation at the undergraduate level. With the proper approach, more courses can provide a course-based undergraduate research experience and increase the number of students with authentic research experiences.

88 - Zero to Conference poster in 30 days: Conducting research within a one month class

Dane Kuppinger, Laura Watts

Salem College, Winston-Salem, NC

Faculty are increasing their use of problem-based learning models which when done well result in increased retention and ability to synthesize content across disciplines. Conducting class-based research can however be challenging due to limitations imposed by 3 hr lab periods and demands on student time. Although shorter winter/summer sessions allow students to focus on a single class, they are often avoided because of the challenges of having multiple lab sessions per week. We suggest however that these are ideal times to teach a problem-based class. In 2015 and 2018, our class studied the Dan River coal ash spill and asked how it had impacted the soil microbial community. The microbial focus gave us something that we could measure within days and the spill's local nature interested students. Teaching the class in a January mini-semester limited the time for research, but also meant that students could focus exclusively on it. Co-teaching brought a broader range of skills to bear and enough faculty eyes and hands to supervise the many assays being run simultaneously.

Protocol testing, set-up, and logistics happened in the fall semester. Salem's small size gives us detailed knowledge of our students and we assigned them to assays that matched their skill sets and dispersed the strongest across groups. We set a high bar by telling students the class would require 8hrs per day and that we hoped to publish the results with them as authors. We divided our 14 students into 4 groups, each with its own set of experiments. After initial guidance, students largely worked independently with peer supervision and repetition largely responsible for the data's high quality. This structure enabled two complete sets of 20 experiments with 3 replicates within 30 days and has resulted in 5 conference posters, 1 publication, and 1 manuscript currently under review.

89 - Bluebirds in the House! A Project for Modeling Scientific Processes to Middle School Students

Annabelle McKie-Voerste[1], Robert Price[1], Tillman Kennon[2]

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Eastern Bluebirds (*Sialia sialis*) are an excellent model species for teaching middle school classrooms (grades 6-8) scientific processes while simultaneously providing students with opportunities for outdoor interaction, cultivating critical thinking, and providing cross-curricular content. Bluebirds are an easily recognized species endemic to the eastern and central United States that operate well in disturbed habitats when offered nesting boxes, thereby making schools with grassy recreational areas perfect for establishing and maintaining a population year-round. This presentation provides an overview of the setup, timeline, and lesson plans pertaining to the scientific process. The first year focus is on nest box construction, their placement, and installation in suitable locations on school grounds with the hope of establishing a new population by Spring. As soon as birds inhabit the boxes, teachers can conduct a model experiment before encouraging students to formulate their hypotheses and test them before the school year ends. In subsequent years, the fall season will be geared more towards the maintenance of the boxes by clearing out old nests during the non-breeding season; further maintenance may include the construction of more boxes or the modification of existing ones. Students will formulate new hypotheses and retest or adjust investigations based on previous results. As they collect this data, students will learn to maintain a database for long-term trend analyses. This project provides cross-curricular content tied to common core standards in science, math, and literacy while following the 5E Instructional Model for education.

90 - How Students Have Learned to Love Histology - comparing WiFi vs regular compound light microscopes

Joni Criswell

Anderson University, Anderson, SC

In 2016 the Anderson University Department of Biology purchased six Motic WiFi compound light microscopes for usage in laboratory classes. All of the BIO 201 (Anatomy and Physiology I) courses began using them during the laboratory unit on cells and tissues. The ability of the WiFi microscopes to directly link to an app on most electronic device (iPads are given to all incoming freshman at Anderson University) and thus show the slide image in real time has drastically changed the scores on lab practicals involving a large amount of histology. One of the WiFi microscopes major benefits has been the ability for instructors to easily see if a student is viewing the correct tissue type since the image is showing up on an electronic device. Also the students are able, within the free MotiConnect app, to write, edit, save and then share images of what is being viewed on the microscopes. The overall class average scores before the introduction of the WiFi microscopes on lab practicals involving a high portion of histology were typically in the C range or below. After the introduction of the WiFi microscopes the overall class average scores for the same test have been constantly in the upper B range.

91 - Patterns of cytonuclear linkage disequilibrium between heteroplasmic and homoplasmic individuals of wild carrot, Daucus carota (Apiaceae), a gynodioecious plant species

Adam Ramsey[1], David McCauley[2], Jennifer Mandel[3]

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Cytonuclear linkage disequilibrium (LD) is the non-random association of alleles between nuclear and cytoplasmic genomes (ptDNA or mtDNA). Patterns of cytonuclear LD can indicate admixture of divergent populations, cytonuclear selection, non-traditional organellar inheritance, or the occurrence of more than one type of mtDNA or ptDNA within an individual (heteroplasmy). Gynodioecious plant species are known to exhibit biparental inheritance of organelles, creating heteroplasmy. We used the gynodioecious plant species, *Daucus carota*, or wild carrot, to investigate cytonuclear LD. We genotyped 265 individuals from two North American regions, 136 from the Olympic Peninsula, Washington State and 129 from Nantucket Island, Massachusetts. We used 15 nuclear microsatellites, one SNP and one insertion-deletion (indel) located in the mtDNA, and one indel located in the ptDNA to calculate nuclear-nuclear LD, cytonuclear LD, and LD between each pair of organellar loci. We were further able to identify over 100 individuals heteroplasmic for one of the mitochondrial SNPs and over 30 individuals heteroplasmic for the plastid indel. Thus, we were able to calculate the same sets of cytonuclear LD values for individuals that are heteroplasmic and homoplasmic (non-heteroplasmic) for the mitochondrial SNP and plastid indel. When considering the SNP or indel variant as the cytotype, differences were found in the LD values between heteroplasmic and homoplasmic groups. In particular, the range of LD values increased when found in the heteroplasmic state. However, between regions, LD values between organellar loci varied, being higher in heteroplasmic individuals in one region, but lower in the second region.

92 - Blazing New Paths to Investigate Blazing Stars: Development of Microsatellite Markers and Evaluation of Species Boundaries between Liatris helleri and Liatris turgida

Logan Clark, Matt Estep

Appalachian State University, Boone, NC

The North American genus *Liatris* is composed of 40-50 species mainly confined to the eastern seaboard of North America (Gaiser, 1946; Weakley, 2015). *Liatris* has been considered a genus of "unusual difficulty" due to intraspecific variability and hybridization between species that has lead to unclear delineation of species boundaries (Gaiser, 1946). This has been the case with *L. helleri* and its closely related congener, *L. turgida* (Gaiser, 1946; Nesom, 2005b). Previous genetic and morphological studies in this species have suggested that *L. helleri* may in fact represent a singular species that would include populations of *L. turgida*. A series of high-resolution microsatellite markers were developed specifically for use in this study and their utility will hopefully provide future studies with the ability to address species boundaries throughout the genus *Liatris*. The present study evaluates the genetic diversity, population structure, and the taxonomic identity of these species within the genus *Liatris* in order to provide land managers and conservation agencies with genetic data to best manage these species and their natural communities.

93 - Investigations of the Forgotten Geum, Geum geniculatum Michx., Bent Avens

Marietta Shattelroe, Matt C. Estep

Appalachian State University, Boone, NC

Geum geniculatum Michx. (Roseaceae), bent avens, is a perennial herb restricted to the high elevations of three mountaintops between North Carolina and Tennessee. Although geographically restricted, occurrences on these mountaintops can have up to hundreds and occasionally thousands of individuals. Because of its limited geographic distribution and affinity for high elevations, it is thought to belong to a group of plants endemic to the southern Appalachians that are considered post-Pleistocene relics including its charismatic cousin *Geum radiatum*. While population size has been monitored, scientific studies are lacking for *G. geniculatum*. Therefore, there is a need for research to understand basic life history traits, pollination biology, population demography, and genetic diversity in order to understand how the species may respond to our changing climate and inform conservation strategies for the species. In order to begin to understand *G. geniculatum* further, a population genetics study was performed to understand genetic variation and connectivity within the species and between populations. Individuals were sampled from the three mountains where it occurs and genotyped using previously developed microsatellite markers for other *Geum* species. Using this data population genetics analysis were completed.

94 - Distribution and Genetic Diversity of the Rare Plant Veratrum woodii (Liliales: Melanthiaceae) in Georgia

Wendy Zomlefer[1], Jason Comer[2], Rima Lucardi[3], James Hamrick[1], James Allison[4]

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Veratrum woodii, a long-lived herbaceous perennial species, has a fragmented distribution with populations scattered in the southeastern and lower midwestern USA. In Georgia, the species has a protection status of rare. This preliminary study focused on verifying historic and/or unvouchered populations in Georgia and characterizing variation and genetic structure within and among all populations in the state. We analyzed AFLP (amplified fragment length polymorphism) data as dominantly inherited markers for 16 populations sampled from Georgia, Florida, and Missouri. Our results suggest that this species overall has relatively low levels of genetic diversity and that differentiation among populations is comparable to species with similar life history traits. Measures of genetic diversity, such as mean heterozygosity, indicate that variation of populations has some partitioning between disjunct northern and southern Georgia (and Florida) populations. However, our analyses imply that watershed assignment, rather than geographic distance, provides a better explanation for variation and population structure. We hypothesize that southern relict populations in Georgia may have served as refugia during Pleistocene glaciations. We conclude that life-history characteristics, low levels of genetic variation, and suppression of ecological disturbance collectively jeopardize populations of *Veratrum woodii* in Georgia.

95 - Phylogeny and Evolution of Asteraceae using Hyb-Seq Data

Jennifer Mandel

University of Memphis, Memphis, TN

Asteraceae (Compositae) comprise more than 25,000 species of sunflowers, artichokes, dandelions and daisies, and represent 10% of all flowering plant species on Earth. Asteraceae are clearly monophyletic however resolving phylogenetic relationships to understand its origin and diversification has proven difficult. Prior to the use of phylogenomics for reconstructing phylogenies for the family, many evolutionary relationships were not well-resolved which has hindered advances in our understanding of the family's origin and historical biogeography. Using probes developed for the Hyb-Seq method, we sequenced approximately 1000 low-copy number nuclear markers plus partial plastomes for 250 species representing all major lineages within the family, which represents the most comprehensively-sampled Compositae phylogeny thus far. Using these data, we generated robust phylogenetic trees using both concatenated and coalescence-based analyses that represent nearly all subfamilies and tribes. In general, the topologies within tribes remain stable in both the nuclear and plastid trees, however relationships among subfamilies differ from existing classifications. We are using fossil data as time calibration points to estimate the age of the family and the origins of its major lineages. Our new phylogenetic reconstruction is providing unprecedented insight into the evolution and historical biogeography of the family including bolstering our understanding into the biogeographic origins, migrations, and diversifications of major lineages within Asteraceae.

96 - Wildfire impacts on below ground microbial communities are strongly dependent on soil layer, location, and burn severity: toward a framework of ecosystem recovery

Shawn Brown[1], Allison Veach[2], Jonathan Horton[3], Ari Jumpponen[4], Richard Baird[5]

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Decades of fire suppression coupled with changing climatic conditions have increased the frequency and intensity of wildfires. The Southern Appalachia region of the United States is predicted to be particularly susceptible to increased fire severity and occurrence. These fires can reorganize local biodiversity and elicit short-term and long-term shifts in microbial communities, which can lead to greater local adaptation and facilitate ecosystem recovery in different ways. Following the record breaking fire season in 2016 in Southern Appalachia, we examined wildfire impacts on below ground communities (Fungi and Bacteria) within two substrates (duff and soil) at two adjacent locations with

similar plant communities (Great Smoky Mountains National Park – Chimney Top 2 Fire and Nantahala National Forest– Cliffside Fire) from replicate plots representing a range of fire severities (Unburned, Low Severity, Moderate Severity, Severe). Differing fire severities changed community composition, but fire severity played a stronger role in structuring bacterial communities than fungal communities. Further, fire impacts on soil communities and functional guilds were location- and substrate-specific with Nantahala National Forest sites responding more strongly to fire than Great Smoky Mountains National Park locations and soil responding more strongly than duff to fire. Despite strong shifts in communities with increasing fire severity, traditional fire responsive (phoenicoid) fungi remain absent, but several fire responsive OTUs are identified, suggesting an expansion in our understanding of these fire responsive microbes. Taken together, our results suggest context-dependency in microbial responses to fire that must be accounted for to generate ecosystem-wide recovery predictions.

97 - Southeastern Islands and Biogeography

Chris Havran

Campbell University, Buies Creek, NC

Since the voyages of Darwin and Wallace, islands have been essential to the development of evolutionary and biogeographic thought. While the isolation afforded by tropical oceanic islands like the Galapagos and the Hawaiian islands have provided stark examples of adaptive radiation, progression rule speciation, founder effect, and many other fundamental evolutionary and biogeographic concepts, islands in southeastern United States are no less important to the development of biogeographic theory. In this presentation we will review historic and contemporary research highlighting the importance of islands in the southeastern United States towards promoting biogeographic research. In addition to discussing islands in marine ecosystems of the southeast, we will also highlight non-traditional island ecosystems including lakes, sky islands, and historical forest fragments.

98 - Phylogenomics Reveals New Insights into the Adaptive Radiation of Beetles on Plants

Duane McKenna

University of Memphis, Germantown, TN

Herbivorous beetles (order Coleoptera) account for a substantial fraction of Earth's biodiversity but the genomic and evolutionary origins of this diversity remain poorly understood. We reconstructed the phylogeny of beetles and undertook comparative genomic studies to reconstruct the evolution and genomic basis of allelochemical detoxification and plant cell wall digestion. Our studies employed a uniquely large phylogenomic dataset representing most extant beetle families. Phylogenetic and temporal analyses resolve previously ambiguous beetle relationships with strong statistical support, reveal a Carboniferous origin of beetles, and indicate rapid diversification of specialized phytophagous beetles in the Jurassic. Based on these data and analyses, beetle genes conveying the ability to efficiently detoxify and metabolize plant biomass appear to have been key to the adaptive radiation of beetles on plants.

99 - Phylogeography of the American Black Bear (Ursus americanus)

Emily Puckett

University of Memphis, Memphis, TN

Studies of species with continental distributions continue to identify intraspecific lineages despite continuous habitat. Lineages may form due to isolation by distance, adaptation, divergence across barriers, or genetic drift following range expansion. We investigated lineage diversification and admixture within American black bears (Ursus americanus) across their range using 22k single nucleotide polymorphisms and mitochondrial DNA sequences. We identified three subcontinental nuclear clusters which we further divided into nine geographic regions: Alaskan (Alaska-East), eastern (Central Interior Highlands, Great Lakes, Northeast, Southeast), and western (Alaska-West, West, Pacific Coast, Southwest). We estimated that the western cluster diverged 67 ka, before eastern and Alaskan divergence 31 ka; these divergence dates contrasted with those from the mitochondrial genome where clades A and B diverged 1.07Ma, and clades A-east and A-west

diverged 169 ka. We combined estimates of divergence timing with hindcast species distribution models to infer glacial refugia for the species in Beringia, Pacific Northwest, Southwest, and Southeast. Our results show a complex arrangement of admixture due to expansion out of multiple refugia. The delineation of the genomic population clusters was inconsistent with the ranges for 16 previously described subspecies. Ranges for U. a. pugnax and U. a. cinnamomum were concordant with admixed clusters, calling into question how to order taxa below the species level. Additionally, our finding that U. a. floridanus has not diverged from U. a. americanus also suggests that morphology and genetics should be reanalyzed to assess taxonomic designations relevant to the conservation management of the species.

100 - The Evolution and Development of Staminodes in Paronychia

Andrea Appleton, John Schenk

Georgia Southern University, Statesboro, GA

Angiosperms have evolved a tremendous amount of variation in floral structures to facilitate reproduction, the driving force of life. Staminodes, which are stamens that have lost their reproductive ability, exemplify how flowers can be modified by evolution. Staminodes have evolved numerous times across angiosperms, including in the nailwort genus *Paronychia* (Caryophyllaceae). To explain the evolutionary origins of staminodes in *Paronychia*, we tested the hypotheses that staminodes are (1) infertile stamens co-opted as nectar guides or pollinator landing platforms, (2) vestigial stamens, or (3) rudimentary or reemergent petals (i.e., not staminodes). We evaluated the developmental series of North American *Paronychia* with scanning electron and light microscopy and conducted ancestral state estimations across phylogenies to infer when staminodes evolved. Preliminary developmental results suggest that staminodes evolved differently between species; in *Paronychia americana*, staminodes develop similarly to stamen in shape and length, and in *Paronychia herniarioides,* differences in staminode shape compared to filaments suggests functional co-option. Staminodes likely evolved early in *Paronychia* and were lost at least twice. Our results suggest a dynamic history of staminodial evolution in *Paronychia*, and, perhaps, that selection on the function of staminodes is different across species.

101 - The evolutionary consequences of heritable microbes that manipulate animal reproduction.

James E Russell

Georgia Gwinnett College, Lawrenceville, GA

Inherited microorganisms are responsible for some of the most consequential evolutionary events in the history of life. The symbiotic relationship associated with ancient vertically transmitted bacteria is a defining characteristic of the eukaryotic domain. Symbioses in which symbiont and host genes are co-transmitted are generally considered mutualistic since the fitness of both parties is linked. A relatively recently discovered class of microbes appears to be reshaping the understanding of the symbiotic relationship between host organisms and their heritable microbial symbionts. Heritable microbial symbionts that manipulate the reproductive systems of their hosts have been discovered that sacrifice the fitness of their hosts for the immediate fitness benefit increased transmission of the symbionts. There is a growing understanding that these parasitic reproductive microbes are widely distributed among arthropods. By targeting the reproductive systems of host arthropods, this class of heritable symbiont has the potential to profoundly impact the evolution of infected host species. The current distribution, ecology and evolutionary consequences of reproductive parasites among arthropods will be discussed in this symposium presentation.

102 - Evolution and Affect: The Detection of an Emotional Response to Evolution

Mark Bland

University of Central Arkansas, Conway, AR, AR

Evolution is the unifying theme and overarching theory in biology, yet rates of rejection of evolutionary science remain high. Anecdotal evidence suggests that cognitive dissonance leading to an emotional response is a barrier to learning about and accepting evolution. We explored the hypothesis that students whose worldviews are inconsistent with the acceptance of evolution generate detectable emotional responses in the form of physiological changes when exposed to evolutionary themes.

Physiological data (respiratory rate, galvanic skin response, and heart rate) were collected from participants while they were asked "yes/no" questions, some of which referenced evolution. Questions were of three categories: relevant, irrelevant, and control. Authenticity of response rates to relevant questions such as "Do you believe in evolution?" were verified, using visual inspection, by comparing them with response rates to control questions, such as "Have you ever cheated on a test?" Our results support our hypothesis. Of the 33 participants included in our study, a majority of them produced detectable physiological changes consistent with emotional responses when asked questions referencing evolution. The highest response rate (79%) was generated by the question, "Do you believe in evolution?" The consequences of providing these students with instruction in evolutionary theory include cognitive dissonance and motivated reasoning. These threats to objective thinking will be discussed.

103 - The phylogeography of the southeastern species of the genus Dalea L. (Fabaceae) using a phylogenetic approach

Joshua Fuller, Desiny Moore, Tom Diggs

University of North Georgia, Oakwood, GA

The genus Dalea (Fabaceae) consists of approximately 160 species with a few species being geographically widespread, and most of the genus being endemic to restricted areas with calcareous substrates. A previous study (McMahon and Hufford, 2004) looked at the phylogeny of the tribe which Dalea belongs to, Amorpheae, and one other phylogenetic study (Diggs, 2013) has been conducted on several species in the genus itself, mainly from the mid-west and coastal plains of Alabama. This study focuses on the phylogeny and phylogeography of Dalea species from the Gulf Coastal Plain, including D. carnea, D. floridana, D. feayi, D. pinnata var. pinnata,D. pinnata var. trifoliata, D. adenopoda, D. mountjoyae, and D. albida compared to two species in the genus Amporpha (Fabaceae) a closely related genus. Phylogeny for Dalea will be determined by DNA sequences taken from the plastid trnK/matK intron, and the nuclear ribosomal ITS1, 5.8S, and ITS2, and compared to sequences obtained from previous phylogenetic studies of Dalea (Diggs, 2013). DNA sequences from all specimens have been obtained for the nuclear loci ITS1 and a majority for matK. Bayesian analysis was performed using MrBayes, and the species we studied grouped with other east coast species. D. floridana falls out as a sister group to D. carthagenesis as it should since D. floridana was once a variety of D. carthagenesis. Both varieties of D. pinnata fall out as separate taxa with 100% probability. D. feayi & D. albida form a polytomy with the D. pinnata group, and warrants further study.

104 - High-throughput flow cytometry and DNA sequencing identifies over 20 potential new species of Isoetes (Isoetaceae, Lycopodiophyta) in the southeastern US

Peter Schafran[1,2], Jay Bolin[3], Carl Taylor[1], Elizabeth Zimmer[1], Lytton Musselman[2]

[1]National Museum of Natural History, Washington, DC, [2]Old Dominion University, Norfolk, VA, [3]Catawba College, Salisbury, NC

Due to extreme morphological simplicity, chromosome number and DNA sequence data have been increasingly used to delimit species boundaries in *Isoetes*. Flow cytometry and next-generation sequencing allow rapid analysis of hundreds of individual plants. Genome sizes measured by flow cytometry correlate with chromosome counts, and phylogenetic analysis of a *LEAFY* intron supports clades matching the morphological taxonomy of species in the southeastern US. After surveying populations of all species of *Isoetes* in the Southeast, we identify over 20 potentially new taxa. New diploid species are supported as monophyletic clades with branch lengths similar to recognized species, and which have been involved in polyploid formation. New polyploid taxa are proposed based on unique combinations of parental genomes, each representing separate hybridization and genome duplication events. Comparisons within and between populations suggest that many polyploid taxa form locally and are not transported long distances.

105 - The systematic value of pollen morphology in Chresta Vell. ex DC. (Vernonieae, Asteraceae)

Carolina Siniscalchi[1,2], Benoit Loeuille[3], Raquel M.B. Souza-Souza[4], José Rubens Pirani[2], Vania Gonçalves-Esteves[4]

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Chresta encompasses 15 species of Compositae, mostly restricted to the Brazilian Cerrado and Caatinga. Previous taxonomic studies have shown that there is variation in pollen types among species, but did not fully describe them. In order to provide full pollen descriptions and analyze their relation to the group's taxonomy and phylogeny, pollen grains from 14 species were examined using light and scanning electron microscopy. Acetolysed pollen grains were measured and photographed on a light microscope and non-acetolysed pollen grains were examined using scanning electron microscopy. Three pollen types were found in the genus, corresponding to *Vernonia*-types A, C and F. In general, pollen grains are isopolar, large, prolate-spheroidal, spheroidal or oblate-spheroidal and the polar area is usually small. The variation in quantitative characters allowed the construction of a dichotomous identification key. Pollen types do not correlate to clades found in the most recent phylogeny of the genus. Similarities and differences of pollen patterns of *Chresta* and other Vernonieae genera are briefly discussed.

106 - Species Dispersal Modes in Amphitropical Plant Species of North and South America

Samera Mulatu, John Schenk

Georgia Southern University, Statesboro, GA

Amphitropical disjunct plants are species that occur in both North and South America but not in the intermediate equatorial region. How amphitropical species dispersed across the Americas to their current distribution still remains uncertain. To explain amphitropical distributions, three hypotheses were developed to test that (1) species dispersed successively through island hopping across the tropical zone in temperate microhabitats (= stepping stones), (2) species came to their current distribution through vicariance, or (3) species dispersed by a single long-distance dispersal event. Twenty-five amphitropical species were studied to infer their historical distributions with species distribution models in MaxEnt. Distribution models for each amphitropical species were estimated under three different timelines: the current climate, the last glacial maximum (22,000 years ago), and the last interglacial maximum (120,000–140,000 years ago). Ecological niche models were generated in MaxEnt with 19 bioclimate variables from the WorldClim database. Across the three time slices, the vicariance hypothesis was rejected in all but one species for one of its time slices. In 13 experiments, the long-distance dispersal and vicariance hypotheses were rejected in favor of the stepping stone hypothesis. In 37 experiments, the stepping stone and vicariance hypotheses were rejected in favor of long distance dispersal. There were three species that could have dispersed by shorter-distance-dispersal events via intermediate dispersal from Mexico. Although our results suggest that long distance dispersal was the most dominant mechanism of dispersal among amphitropical species, they also convey that that numerous shorter-distance-dispersal events via intermediate, favorable populations are an underappreciated mode of dispersal in amphitropical species.

107 - Staminode Evolution in Mentzelia Section Bartonia (Loasaceae) and their Impact on Insect Visitation Rates

John Schenk, Lucia Botnaru

Georgia Southern University, Statesboro, GA

Staminodes are infertile stamen that have evolved numerous times across angiosperms; however, very little is known about the evolutionary transitions of staminodes, especially among close relatives. We studied staminode evolution in *Mentzelia* section *Bartonia* to determine how many times staminodes have been gained or lost. A maximum-likelihood approach identified ten transitions, in which staminodes evolved at least five times and were reversible. We then examined the visitation consequences of staminode evolution by quantifying how staminodes affect visitation rates. A population of *Mentzelia multiflora* was used in an experimental study where visitation of control

flowers (staminodes present) was compared to treatment flowers (staminodes removed). The only pollinator was *Apis mellifera* (Apidae), who significantly hovered above and landed on control more than treatment flowers. Despite the preference to land on staminodial flowers, once landed, pollinators spent an equal time on control and treatment flowers. We hypothesize that the increased visitation of staminodial flowers likely offsets the loss of the reproductive function in stamens.

108 - Phylogeny, Character Evolution, and Biogeography of Antennaria (Gnaphalieae, Asteraceae) Inferred from Hundreds of Loci

Ramhari Thapa, Randall Bayer, Jennifer Mandel

University of Memphis, Memphis, TN

Antennaria Gaertn. are dioecious perennial herbs distributed mainly in the Holarctic Region with the major center of diversity in the Rocky Mountains of Western North America. The genus comprises 34 known sexual diploid/tetraploid species and several polyploid agamic complexes which mostly reproduce by forming asexual seeds. The dioecious nature, extensive hybridization, polyploidization, and the development of gametophytic apomixis, all have contributed to the complex evolutionary history in the genus. We performed a phylogenomic study of the sexual *Antennaria* species using a novel target enrichment method with custom capture probes designed to work in species across the entire Asteraceae family. Information from hundreds of nuclear loci resolved *Antennaria* as a monophyletic group except for the doubtful *Antennaria* species, *A. linearifolia*, and the genus was further resolved into three distinct, major lineages. Reconstruction of the ancestral states of 28 taxonomically important morphological characters offered support for 12 characters for various clades in the phylogeny. Inferences of ancestral ranges with the best fit model, Bayarealike+*j* , in the BioGeoBEARS package estimated the Rocky Mountain region of North America, including Vancouverian province, as the center of origin for the genus *Antennaria* around 5.7 MYA. Dispersals of the genus into the Arctic and Appalachian provinces, Canadian provinces and Eurasia took place roughly 3.3 MYA, 2.5 MYA and 1.6 MYA respectively. Biogeographical Stochastic Mapping indicated that 51.4% of the biogeographical events were based on within-area speciation (sympatry). The remaining 48.6% of the events were divided into two types of dispersals: i) range expansion dispersals (anagenic, 37%) and ii) founder/jump dispersals (cladogenic, 11.6%). The results of the study will be valuable for providing a framework for future evolutionary studies including species diversification, and the origination of polyploidy in *Antennaria* species.

109 - A rangewide herbarium-derived dataset indicates high levels of gene flow in black cherry (Prunus serotina)

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Isolation by Distance (IBD) is a genetic pattern in which populations geographically closer to one another are more genetically similar to each other than populations which are farther apart. This basic biogeographic hypothesis has been studied in relatively few North American plant taxa, and no IBD study has rigorously sampled across the range of a truly widespread North American species. In this study, IBD was assessed in eastern black cherry (*Prunus serotina* Ehrh. var. *serotina*) (Rosaceae), a widespread North American forest tree. Dense sampling across the entire range of eastern black cherry was made possible by genotyping 15 microsatellite loci in 439 herbarium samples representing 34 collections. Genotyping success was high, with a modest negative effect of specimen age and no effect of herbarium of origin. Mantel tests demonstrated significant but weak IBD, suggesting widespread gene flow in this taxon. This is consistent with *P. serotina*'s status as a disturbance-associated species, and further studies should similarly evaluate IBD in species characteristic of low-disturbance forests.

110 - Dichanthelium (Poaceae) of Arkansas: from 16 to 46 species

Justin Thomas

NatureCITE, Springfield, MO

The Arkansas Natural Heritage Commission has been funding statewide taxonomic revisions of difficult genera believed to include cryptic taxa of conservation concern. Such funding of floristic and systematic work is vital to accurately informed conservation planning. *Dichanthelium* (Poaceae; Rosette/Panic Grass) is the second largest genus of vascular plants in eastern North America and offers a model genus for exploring contemporary species concepts. The state of Arkansas provides a good geographical location for a review of taxa, given *Dichanthelium's* center of diversity in the southeast. Extensive field collecting and a review of nearly 5000 specimens resulted in an update from 16 to 46 species occurring in Arkansas; several of which are imperiled. All reviewed specimens were annotated, imaged, and their locations mapped. This talk will address some of the more interesting discoveries that this research has elucidated, and encourage other state programs to better fund such projects.

111 - Breeding Success in Xenopus laevis raised in laboratory at Jacksonville State University (JSU)

James Rayburn

Jacksonville State University, Jacksonville, AL

Xenopus laevis, the African clawed frog is a commonly used model organism for a variety of biological research. Many universities keep colonies of these organisms for educational and research purposes. At smaller universities like JSU limited space means keeping a relatively small colony of 8 to 10 pairs of breeding frogs. This means an understanding of breeding success under these conditions in necessary to plan for both education and research purposes. Since June 2010 a record of all breeding events, conditions of breeding, frog mating, number of eggs, number of fertilized eggs and if the embryos were viable for up to 96 hours has been recorded. Frogs were kept in in the laboratory under a 12 hr light:12 hr dark cycle at room temperature and were feed ¼ teaspoon 1/8 inch frog pellets daily. Injections of Human Chorionic Gonadotropin into the dorsal lymph sac the day before were used to induce breeding. Frog breeding have occurred in every month of the year, with some have more frequency than others due to university schedule. Using Systat stastical software, means, standard deviations and correlations of breeding with month of the year were calculated. These results indicate that the success rate is high. These results indicate that you can induce successful breeding in any month of the year.

112 - Hypotheses of Assemblage Organization in Appalachian Dusky Salamanders: A Critical Re-examination

Carlos Camp

Piedmont College, Demorest, GA

Dusky Salamanders of the genus *Desmognathus* are ubiquitous in streams across the southern Appalachians in assemblages ranging from three to six species. Invariably, syntopic species occupy different points along a moisture gradient from stream to forest. Body sizes of different species are correlated with preferred habitats with large species being more aquatic and small ones being more terrestrial. Originally believed to represent habitat partitioning among competitors, interspecific predation was later proposed as the primary selective force driving habitat adaptation. Research over more than two decades led to the general consensus that a combination of interspecific competition and predation has driven habitat adaptation along this moisture gradient. A critical look at the evidence, however, reveals that neither competition nor predation fully explains observed patterns and that fundamental predictions of the two hypotheses fail. Moreover, recent changes in our understanding of the phylogenetic relationships within the genus have negated some of the assumptions upon which these hypotheses were based. I use the scientific standards of repeatability and predictability to examine the competition-predation hypothesis and critically evaluate the idea in light of recent advances in our knowledge of the biology of these animals. I conclude that, while both competition and predation influence the interaction of different species, neither force, either alone or in concert, satisfactorily explains the ecological organization of these assemblages.

113 - Upland Snake Community in Restored Montane Longleaf Pine Habitats in Paulding and Sheffield Wildlife Management Areas

Miranda Gulsby

Kennesaw State University, Kennesaw, GA

The Paulding and Sheffield Wildlife Management Areas (WMA) in northwest Georgia are undergoing montane longleaf pine ecosystem restoration for the past 15 years. Habitat management using prescribed fire and canopy thinning are shown to benefit reptile communities creating increasing diversity of species. Many reptile and snake communities are in decline however, no surveys have been conducted to determine occupancy of reptiles within these WMAs undergoing restoration. This study is an initial survey of the upland snake community after 15 years of ecosystem restoration occurring. In Northwest Georgia, the upland snake community includes 11 species based on their habitat preferences. This community includes the northern pine snake (*Pituophis melanoleucus melanoleucus*), a species of concern in Georgia, however, this species was assumed to be extirpated from these WMAs. We utilized drift fence arrays with box funnel traps to survey the upland snake community in both WMAs during two seasons, an early summer (May – June) and a late summer (late-August - late-October) in 2018. Snakes captured in the traps and found incidentally on roads were handled to collect morphometric data and swabbed to collect samples to evaluate the presence of Snake Fungal Disease pathogen (*Ophidiomyces ophiodiicola*). Currently, swabs are being tested for the pathogen. This snake community survey confirmed the presence of northern pine snakes in both WMAs. Sheffield contained a higher species diversity during both seasons. Seasonal variation was observed with higher species richness and evenness in Sheffield during the first season then higher in Paulding during the second season. However, of the 11 species considered to be in the upland snake community, 3 species were not found. We found that the mosaic of disturbance-maintained habitats in these WMAs are supporting high species diversity and can be used as a baseline for future studies of managed habitats in northern Georgia.

114 - Prey Selection in the Queen snake, Regina septemvittata, in Streams of the Northern Panhandle of West Virginia, U.S.A.

Dan Meyer[1], Elijah Henderson[2], Zachary Loughman[1]

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Regina septemvittata (Queen snake) is a semi-aquatic snake occurring throughout central and eastern North America that exhibits extreme dietary specialization, feeding almost exclusively on freshly molted crayfishes. Though it is known *R. septemvittata* forage on crayfishes, little is understood about prey preferences at the species and genus level. Because different crayfish species have varying life history patterns, and molting frequency is allied to life history attributes, it is not clear whether there is a preference based on crayfish species or prey availability based on molt state. To determine if *R. septemvittata* has preferences for species, we surveyed four streams in the northern panhandle of West Virginia for *R. septemvittata* and completed seasonal life history studies on crayfish species occurring in those streams from March through October 2018. Over the collecting season 101 Queen snakes were captured. From these, we recovered 24 prey samples that were subsequently identified using either polymerase chain reaction (PCR) or visual identification. Monthly crayfish sampling was used to determine molting frequency of the two available prey species in the study streams: *Cambarus carinirostris* and *Faxonius obscurus*. Preliminary results seem to indicate that freshly molted crayfish availability dictates foraging behavior in *R. septemvittata*, and a lack of specialization at the taxonomic level occurs in this species.

115 - Inter- and intra-population variation in spatial ecology of Eastern Box Turtles (Terrapene carolina) in fire-maintained and unburned forests

Dr. John Roe

University of North Carolina Pembroke, Pembroke, NC

Prescribed fire is an essential tool for the conservation and management of forest communities in the Southeastern United States. While such management practices may result in the unintentional injury or killing of box turtles, we know little regarding how turtles respond behaviorally, including how fires influence movements and use of space. From 2012 – 2016, we radiotracked turtles at fire-maintained

and unburned protected areas and examined inter- and intra-population variation in movement rates and home range size. Home range size was larger for females than males using both minimum convex polygon and 95% kernel density estimates, and individuals at the unburned site maintained larger home ranges than at the fire-maintained site according to the 95% kernel density method. Home range fidelity, measured as the proportion of spatial overlap in area from year to year, was higher for males than females and higher at the fire-maintained site compared to the unburned site. For individuals at the fire-maintained site, home range size decreased with increasing fire frequency and extent. Movement rates increased with body size and were higher in females than males only in July, but individuals at the fire-maintained and unburned sites moved at similar rates. Our initial results suggest that fire may have important effects on the spatial ecology of terrestrial turtles by constraining their home ranges to relatively small areas of fire refuge habitats such as mesic forests and areas near watercourses. Such behavior could be a strategy to avoid the dangers, such as injury and mortality from fire, that come with exploration into pyrogenic habitats. Further studies that assess the response of box turtles to fire over longer time-frames, or following experimental manipulations of fire regimes, would help land managers understand the implications of current management practices for non-target biota.

116 - Herpetological assemblages in reforested tropical dry forests of the Azuero Peninsula, Panama

Tyler Kovacs, Heather Griscom

James Madison University, Harrisonburg, VA

Tropical dry forests are considered one of the most endangered tropical ecosystems making reforestation increasingly necessary to restore Panama's unique ecoregion. The isolated dry ecoregion surrounding the Bay of Parita in Panama has a long history of deforestation and cattle grazing. Successful reforestation of this land is important to restore ecosystem health and biodiversity. In Panama, reforestation ranges from monocultures of exotic teak (*Tectona grandis*) to passive regeneration. Faunal recovery within these reforestation systems may vary due to different habitat characteristics. In this study, amphibian and reptile communities were compared in two types of reforestation systems and protected riparian forests in the dry ecoregion of the Azuero Peninsula, Panama. A 13-year-old secondary forest and a 13-year-old teak plantation were assessed, each containing a forested riparian area. Old secondary forests (80+ years) and an active cattle pasture were used as reference sites to represent low and high disturbance habitats. The 13-year-old secondary forest had higher site richness along with a more complex community composition compared to the 13-year-old teak plantation. Results indicate the importance of protected forested riparian areas, which had significantly more abundant herpetological communities at each site ($p < 0.05$). These riparian forests may serve as sources for species that are recolonizing reforested areas. Additionally, analyses of habitat characteristics indicated increasing tree diversity promotes a higher abundance of herpetofauna at reforestation sites. Along with the preservation of forested riparian areas, we suggest reforestation practices that increase tree diversity, even if timber production is the main goal.

117 - The Influence of Exotic Plant Leaf Litter on Amphibian Growth and Development

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Leaf litter from surrounding vegetation is an important source of energy to ponds. Natural litter substrates serve as a nutrient source for the aquatic food web, but changes in plant species composition can alter chemical features and nutrient dynamics in aquatic systems that subsequently impact aquatic taxa. The invasion of exotic species into forests can alter environmental resources in wetland ecosystems that serve as critical breeding sites for amphibians. Amphibians are one of most threatened classes of vertebrates due to multiple factors, but little research has been conducted about the effects of non-native plants on the breeding sites and development of amphibians. It is important to investigate the factors that influence tadpole development because larval mass and timing of metamorphosis are closely linked to individual fitness. We investigated the input of both exotic and native leaf litter species on green frog, *Lithobates clamitans*, growth and development using a randomized complete block experiment. Eight leaf litter treatments, *Pinus palustris, Quercus phellos, Lonicera japonica,* and *Ligustrum japonicum* all with the presence and absence of tadpoles, were replicated five times for a total of 40 experimental units. We collected data on water quality,

algal resources, and tadpole growth periodically during the experiment. We found that leaf litter species altered nutrient cycling that in turn affected the development of amphibian larvae, the mass, and timing of metamorphosis. Exotic leaf litter produced up to a 300% larger larval mass than the native leaf litter, and up to a 100% increase in the biomass of periphyton and phytoplankton. This research will provide insight into how exotic species removal might affect habitat quality and the maintenance of biodiversity at amphibian breeding sites.

118 - The Phenology of the Symbiotic Association between Ambystoma Maculatum and Oophila Amblystomatis Using Molecular Techniques

Griffin McDaniels, Chris Murdock, George Cline, James Rayburn

Jacksonville State University, Jacksonville, AL

In the waters of the stochastic micro-ecosystem of the wetland vernal pool, a unicellular alga is found within the cells and tissues of developing spotted salamanders (*Ambystoma maculatum*). This symbiosis appears to be mutualistic with involved parties trading nitrogen, oxygen, and carbon dioxide; but the broader ecology the interaction has yet to be thoroughly explored. This study seeks to examine the spatial and temporal distributions of the endosymbiotic algae among developmental stages of embryo, between egg-masses, and within and between several vernal wetlands in Northeast Alabama. After verifying the efficacy of published genetic primers for the algae and developing real-time PCR primers, a systematic detection protocol was established using environmental DNA (eDNA) techniques. Salamander eggs were collected from the field at several sites, aged, and tested for algal genetic material. Water samples were taken monthly from the focal site of this study (Henry Farms Park, Jacksonville AL), and periodically from other sites with known *A. maculatum* breeding activity. Here, we provide evidence that the transfer of the algae is environmental and occurs rapidly after deposition of the eggs into the pond. Of the over 150 egg masses sampled, only those collected at Harrison stages 1 tested negative for algal genetic materials. Algae presence was also detected in the waters of the pool at the date of filling, before salamanders arrived to breed.

120 - Regulation of Cell Fate Decisions in Mus Musculus Preimplantation Blastocysts

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Epithelial trophoblast stem (TS) cells in the trophectoderm of the pre-implantation blastocyst undergo a key morphogenetic process called epithelial-mesenchymal transition (EMT). During this process, epithelial TS cells with apical-basal polarity and tight cell-cell adhesion convert to invasive, mesenchymal giant cells that invade the uterus and establish placentation. We have discovered that a key kinase, MAP3K4 is important in regulating this developmental EMT process in TS cells. Importantly, inactivation of the kinase MAP3K4 (KI4) results in premature EMT in TS cells, leading to hyperinvasive trophoblasts and defective decidualization. TS cells isolated from mice expressing an inactive kinase MAP3K4 (TS^{KI4}) are mesenchymal-like with front-back polarity relative to wild-type epithelial TS (TS^{WT}) cells. Using DNA microarray data, we identified an O-GalNAc glycosyltransferases, *Galnt3*, whose expression is reduced in mesenchymal TS^{KI4} cells. Based on these preliminary findings, we predicted that GALNT3 might be important for epithelial state maintenance in TS cells. To define the role of GALNT3 in TS cells, we examined the impact of loss of GALNT3 in the trophectoderm of the pre-implantation blastocysts. shRNA knockdown of GALNT3 in the trophectoderm results in premature attachment and outgrowth (EMT) of the blastocyst. Importantly, loss of GALNT3 results in decreased total O-GalNAc glycosylation at the cell surface of the pre-implantation blastocysts. Further, we observe reduced O-GalNAc glycosylation at the sites of attachment and outgrowth, suggesting loss of O-GalNAc glycosylation is a normal process during development. Together, these data demonstrate the impact of glycosylation on the blastocyst development and implantation.

121 - Conserved Mechanism of Eukaryotic Histone-Induced Cytochrome C release

Vanessa Chappell

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Previous studies with mammalian mitochondria showed that each of the core HPLC purified histones could bind to mitochondria and cause release of cytochrome C and other proteins that promote apoptosis. We hypothesize that histone-mitochondrial interaction and histone-induced cytochrome C release may be broadly conserved across eukaryotes. We find, using partly purified histone fractions, that in both yeast and cauliflower, histone H3 binds to mitochondria and the histone enriched fraction causes cytochrome C release from the mitochondria. Additionally, commercially prepared mammalian histones also showed H3 binding to both yeast and cauliflower mitochondria, suggesting that histone interactions with the outer membrane of mitochondria may be a highly conserved mechanism across a broad range of eukaryotes. Unlike the data previously reported in mammalian cells, H2A and H2B from partly purified mammalian, yeast or cauliflower histones failed to bind significantly to either yeast or cauliflower mitochondria. Our data suggests that H3-mitochondrial interaction may be controlled by either a channel on the outer membrane of mitochondria allowing the histone protein to be taken in, or by a tightly bound surface receptor that is not easily disturbed. Our data also suggests that this interaction between histones and mitochondria may be competitive between different histone proteins where H3 outcompetes both H2A and H2B histone proteins for access to this hypothesized mitochondrial interaction.

122 - Neprilysin: A Possible Regulator of PI3K Signaling in Triple Negative Breast Cancers

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Lipscomb University, Nashville, TN

Triple-negative/basal-like breast cancers (TNBC) comprise 15-20% of breast cancer cases and are frequently therapeutically resistant to both traditional chemotherapy and targeted therapies. Therefore, identifying molecular targets and predicting the sensitivity of these targets is an important ongoing research goal with these cancers. The Phosphoinositide 3-kinase (PI3K) pathway is commonly mutated in TNBCs, and its inhibition has been clinically tested in PI3K-mutant TNBCs. However, clinical trials have so far demonstrated mixed results among TNBC patients. This emphasizes the need to better understand the molecular mechanisms that drive TNBCs and identify possible biomarkers for sensitivity to TNBC inhibitors. Recent studies in our lab implicates neprilysin, a cell surface endopeptidase expressed on breast epithelial and stromal cells, as a candidate regulator of PI3K signaling in TNBCs. In a previous study our lab found that neprilysin negatively regulates breast cancer invasion and it is silenced through promoter methylation in aggressive breast cancers. Our current study's purpose was to determine whether neprilysin is associated with cancer related proteins in TNBC cells. Bioinformatics analysis strongly suggested an association between neprilysin expression and PI3K pathway activation in TNBC cell lines. To directly assess this association, we transfected a neprilysin vector in neprilysin-low triple negative breast cancer cell lines and measured phosphorylation of AKT, the primary mediator of PI3K signaling, at Threonine 308 and AKT1/2 and Serine 473 using Western blots. We found that expressing neprilysin in the MDA-MB-231 cells alters phosphorylation of AKT at T308 and AKT1 at S473 while no significant differences in AKT2 phosphorylation were observed. Therefore, our results suggest that neprilysin may have a role in regulating PI3K/AKT signaling in TNBC.

123 - Stability of CFTR on plasma membrane of a lung epithelial cell line.

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INTRODUCTION: CFTR (Cystic Fibrosis Transmembrane-conductance Regulator) function as a chloride ion channel on epithelial cells of many organs. Mutations impairthe function of CFTR, and are responsible for causing the pulmonary disease cystic fibrosis. Our laboratory has shown that the plasma membrane half-life of the most common of CFTR mutations (DF508) is much shorter (~4 h) than that of wild-type CFTR (>48 h). [Heda et al, 2001]. HYPOTHESIS: We hypothesize that this reduced DF508-CFTR half-life may be due to the distinct role of proteasomes, lysosomes and/or CFTR-protein(s) interactions. In this study we present the effects of inhibitors of proteasomes and lysosomes on stability of plasma membrane DF5080-CFTR. METHODS: Epithelial cell lines from human lung (CFBE) stably transfected with DF508 or wild type CFTR were pre-treated with 5 mM sodium butyrate at 27°C for about 60 hrs to up-regulate the plasma membrane CFTR expression. Cells were then "chased" at 37°C in the presence of protein synthesis inhibitor (cycloheximide) and/or

inhibitors of proteasomes (MG132, lactacystin, ALLN, leupeptin), or lysosomal enzymes (E64, EST, chloroquine). Cell lysates were prepared and immunoblotted with anti-CFTR antibody. CFTR-specific signal was detected by chemiluminescence using c300 image analyzer (Azure Biosystems). RESULTS: All inhibitors except for chloroquine partially rescued the degradation of plasma membrane DF508-CFTR in CFBE cell line. Little or no synergistic effects were observed when these inhibitors were used in combination. CONCLUSION: These data suggest that CFTR degradation is partially controlled by proteasomes and lysosomal enzymes.

124 - Investigating the Assembly Pathway for the Yeast Mitoribosomal Small Subunit

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Mitochondrial ribosomes (mitoribosomes) are vital to the production of cellular energy in the form of ATP as they synthesize proteins integral to the process of oxidative phosphorylation. Mitoribosomes consist of two major units, the large subunit (mtLSU) and the small subunit (mtSSU). Information on the role of proteins and how they are assembled to form the mtSSU is very limited. We hypothesize that the majority of mtSSU proteins are essential for assembly and that assembly occurs by the hierarchical incorporation of protein subunits and clusters. In order to investigate the assembly pathway for the small subunit, we have systematically deleted 34 genes coding for mtSSU mitochondrial ribosomal proteins (MRPs) in the yeast *Saccharomyces cerevisiae*. A series of genetic and biochemical experiments are being performed on the MRP mutant strains to assess growth capacity, mitochondrial function, and MRP function. We have tested 32 deletion mutants for their ability to respire. Of those examined, 27 were incapable of growing in the presence of a non-fermentable carbon source, indicating that their mitochondria were nonfunctional. These results disclose that of the 32 proteins analyzed, 27 are essential for the assembly of the small subunit, as expected, while 5 are dispensable for mtSSU formation and function. Mutant rates of cellular respiration and mitochondrial protein synthesis have also been examined in order to determine MRP essentiality to mitochondrial function. From these experiments, we have concluded that all of the MRPs, whether essential or not to mtSSU formation, are vital for optimal mitochondrial function with one exception. We plan to continue our investigation on mtSSU biogenesis by characterizing all mutant strains with the aforementioned tests as well as using immunoblotting and sucrose gradient analysis to gain insight on how MRPs are assembled to form the small subunit.

125 - Regulation of Drosophila nociception by RNA-binding proteins

Andrew Bellemer

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Nociception consists of the detection and processing of noxious stimuli by the nervous system. This process is essential for the avoidance of potentially harmful stimuli in the environment. In many animals, specialized sensory neurons called nociceptors are responsible for the detection of noxious heat, harsh mechanical touch, and dangerous chemical stimuli. Nociceptors frequently exhibit sensitized responses following tissue damage or inflammation, and this plasticity is known to require changes in gene expression. *Drosophila* larvae exhibit a characteristic nociception behavior that provides a powerful behavioral model for studying the cellular and molecular mechanisms that control nociceptor function. Using an RNAi knockdown screen, we have shown that the sensitivity of nociceptors in *Drosophila* larvae is regulated by the function of diverse RNA-binding proteins that may regulate gene expression post-transcriptionally. Our results suggest specific roles for translation initiation factors in regulating the baseline sensitivity of *Drosophila* nociceptors to noxious thermal and mechanical stimuli. Additionally, translation initiation factors are required for nociceptors to become sensitized to noxious stimuli following UV-induced tissue damage. These results suggest that gene expression changes that regulate nociceptor plasticity may occur at the level of translation and RNA metabolism, with initiation of translation potentially acting as a rate-limiting step. By identifying the mechanisms that regulate nociceptor function post-transcriptionally, as well as the genes that are the targets of this regulation, we hope to identify a novel class of targets for treatment of clinical and chronic pain.

126 - Development of microsatellite markers to investigate recurrent polyploidy within the genus Dicentra.

Jessie Hatcher, Lindsay Shields, Matt C. Estep

Appalachian State University, Boone, NC

The genus *Dicentra* (Fumariaceae, Bernhardi 1833) is a small group of herbaceous plants containing seven species found in North America and one species found in eastern Asia. Three species; *D. eximia, D. cucullaria*, and *D. canadensis* display an interesting polyploid series in the Southern Appalachians, where *D. eximia* is a diploid (2N=16), *D. cucullaria* is a tetraploid (2N=32) and *D. canadensis* is an octoploid (2N=64). To investigate recurrent polyploidy within the genus, a set of microsatellite markers are needed to assess whether populations are more closely related by ploidy level or geographic location. 50 primer pairs were identified with various microsatellite motifs via sequence data from *D. cucullaria*. These primer pairs were first tested on a small number of individuals including all three species. Those that successfully amplified across all samples were fluorescently labeled and submitted for genotyping. Chromatograms were assessed for ease of scorability and allelic diversity.

127 - A Comparison of Bee Communities and Floral Resources in Agricultural Fields and Surrounding Natural Areas in Southern Illinois

Leila Kassim, Casey Bryan, Karla Gage, Sedonia Sipes

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Agriculture intensification has changed the landscape across southern Illinois, and has led to the loss of natural and semi-natural areas necessary for providing habitat and floral resources to pollinators, particularly to bees. Further minimization of agricultural weeds and elimination of fallow rotations has added insult to injury by reducing foraging resources even more. Pollinators provide valuable ecosystem services that are fundamental to human survival, yet recent studies have shown pollinator declines and degradation of pollinator networks in Illinois and elsewhere in the eastern US. The objective of this study was to evaluate the differences in floral resources and pollinator communities in 17 natural areas and 16 managed agricultural fields at Crab Orchard National Wildlife Refuge in southern Illinois. Sampling followed standardized methods combining hand netting and pan traps to achieve a better representation of the bee community. For the May 2017 samples, natural sites averaged approximately twice the alpha diversity of the agricultural sites for both floral diversity (20.93 vs. 11, respectively) and bees (20.18 vs. 9.28), but the two groups of sites had similar beta diversity. NMDS and PERMANOVA indicated significant differences in both floral and bee community composition between natural and agricultural sites. An Indicator Species Analysis found *Andrena nasonii*, *Augochlora pura*, *Augochlorella aurata*, and *Lasioglossum* spp. to be significant indicators of natural sites; no significant indicator species were found for agricultural sites. Weeds and other non-native plants were important floral resources in both natural and agricultural sites, suggesting these play an important role in supporting pollinators in agricultural and mixed-use landscapes.

128 - Oviposition Site Choice and Larval Development of Odonates (Anisoptera) in Response to a Predatory Fish

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University of Mississippi, University, MS

The reproductive success of many aquatic insects is highly dependent on where they choose to deposit their eggs. Not all aquatic habitats are created equal, as some are more favorable than others for larval development and it would be evolutionarily advantageous for an ovipositing female to differentiate between them and choose the most suitable for her offspring's survival. In the case of dragonflies, insufficient scientific evidence exists to support the hypothesis that this group can detect cues from potential habitats and use them to determine habitat quality. This study investigates if female dragonflies actively avoid ovipositing in sites containing predatory fish that potentially inflict significant fitness costs via predation to their offspring. Artificial ponds (mesocosms) were filmed using video cameras to observe how many and what species of dragonflies oviposit between two treatments: (1) fish and (2) fishless habitats. A second study seeks to determine to what degree predation by *Lepomis cyanellus* (Green sunfish) affects survival and other fitness correlates of larval dragonflies. Two separate experiments test the lethal and non-lethal effects of predatory fish on larval

odonate development against a fishless control. First instar dragonfly larvae are raised in mesocosms containing one of two treatments: (1) no predator or (2) an individual *Lepomis cyanellus*. All emerging adult dragonflies are counted, measured for length, and total days to emergence. Two identical development experiments will be performed with a single differing aspect: one with a free swimming fish (lethal) and the other with a caged fish (non-lethal). Results of this study will fill a gap in scientific knowledge regarding odonate oviposition behavior and ecology, and have implications for the conservation of crucial invertebrate mesopredators.

129 - Anchialine lakes of the Bahamas support unusually dense populations of Acetabularia spp. and other Dasyclade algae.

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Anchialine ponds in the Bahamas (i.e., those with subterranean connections to the sea) often support communities that are more typical of shallow marine environments (e.g., reefs and estuaries). Anchialine communities are replicated within and among islands and their biotic and abiotic environments can vary considerably over time and space. By comparing macroalgal population dynamics in anchialine and non-anchialine sites, we are attempting to better understand how marine communities respond to large-scale environmental change. For example, in some anchialine habitats, *Acetabularia crenulata, A. calyculus,* and *Batophora oerstedii* (all Dasycladacea) form "mats" of growth that are far larger and denser than those from nearby marine and estuarine sites. Such mats can even be found in ponds that exhibit extreme abiotic fluctuations—fluctuations that have no apparent analogs in non-anchialine sites. An example is Reckley Hill Settlement Pond on San Salvador Island where salinity can vary from one-half to more than twice the average for seawater (35ppt) depending on seasonal precipitation. Yet, Dasyclad communities thrive there. Have they adapted to persist in novel conditions, or do they die back and recolonize later? The results from a recent undergraduate study using *A. crenulata* from Florida suggest that marine populations grow best at 35-53ppt with a more than sixty-percent reduction in growth rate at higher (61 – 70ppt) and lower (17 – 27ppt) salinities. While we have yet to test the tolerance of populations from the Bahamas, forthcoming trials should help us to better understand whether anchialine Dasyclads respond to stress differently than their marine and estuarine counterparts. Because Dasyclad algae are primary producers, such responses could scale up to affect other trophic levels. As such, anchialine Dasyclad communities in the Bahamas could be natural stress labs for investigating the community and ecosystem effects of climate change and other anthropogenic threats to near-shore marine environments.

130 - Do Fiddler Crabs Influence Plant Growth and Soil Chemistry? Getting to the Bottom of the Burrow in Gulf Coast Tidal Marshes

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Bioturbation by fiddler crabs may enhance plant productivity by ameliorating stressful soil conditions in coastal ecosystems, thereby contributing to marsh sustainability in the face of rising sea levels. Fiddler crab-plant interactions in Gulf Coast tidal marshes are poorly understood and have not been closely examined across the dominant vegetation zones. We hypothesized that burrow density, a proxy for crab abundance, would differ across zones and would have a negative relationship with soil organic matter, moisture, electrical conductivity, and soil hardness but a positive relationship with pH, redox potential, and plant biomass. In January 2017, we initiated a fiddler crab reduction experiment by constructing enclosures and exclosures in the four dominant vegetation zones (salt marsh, brackish marsh, fresh marsh and salt panne) at Grand Bay National Estuarine Research Reserve, Mississippi, USA. Species and sex of fiddler crabs were recorded and compiled over the course of the study. Soilsampled in July and November 2017. Following our final measurement, all vegetation was removed, allowing for thorough burrow counts. Collectively, our results highlight variability in fiddler crab-plant interactions and suggest that bioturbation is facilitative in zones characterized by waterlogged soils, but sometimes destructive in drier habitats. *Uca longisignalis* was the dominant

fiddler crab species in the salt (90%) and brackish marshes (75%), where male to female ratios were highest. In contrast, fresh marsh and salt pannes had higher crab diversity and more even sex distributions. The final burrow survey revealed an inordinate number of burrows hidden under fresh marsh vegetation. While few studies acknowledge fresh marsh as fiddler crab habitat or document effects of bioturbation on fresh marsh vegetation, our research indicates that this zone may actually be preferred by Gulf Coast fiddler crabs and quite possibly a habitat "bridge" for upslope migrations as sea levels rise.

131 - Effects of environmental conditions on survival of a bird-dispersed mistletoe, Phoradendron leucarpum

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Mistletoes are a group of shrubs that typically parasitize the branches of host trees and rely on avian frugivores for seed dispersal. Because mistletoes are restricted to a narrow range of suitable recruitment sites and avian frugivores are more visible than other guilds of seed dispersers, mistletoe-frugivore systems afford opportunities for determining the roles of dispersal limitation and local environment in determining plant distribution. We used a seed sowing experiment to quantify the roles of light availability and flood regime in determining the initial survival of oak mistletoe (*Phoradendron leucarpum*). During winters (Jan-Mar) 2016-2018 we planted 1000 oak mistletoe seeds across 50 plots in forested wetlands in southeastern Virginia on a variety of potential host tree species. In winter 2018 we planted 580 oak mistletoe seeds on potted red maple (*Acer rubrum*) saplings under a range of light availability and flood regime treatments using a split plot design. Mistletoe seedling survival and establishment data were analyzed using generalized linear models and the results suggest that light availability has a significant effect on seedling establishment. This information will be coupled with results from a regional co-occurrence study using presence-absence data on both oak mistletoe and avian frugivores to determine the relative influences of environmental conditions and seed disperser behavior on oak mistletoe distribution.

132 - The role of continuous flowering phenology in neotropical plant-pollinator interactions across an elevation gradient

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The neotropics hosts an exceedingly high diversity of plant-animal mutualisms compared to other systems. A unique phenology can be observed in some of the understory shrub layer species, which contributes to the predictability of resources in these systems. Species with this phenology produce flower and fruits through all months of the year; these species represent ideal candidates for testing several theories associated with mutualistic network studies. Some theories suggest plants with a longer reproductive phenophase have a more diverse visiting assemblage due to the accumulation of more partners over time and are thus most connected within network. Two native shrub species with a continuous flowering phenology can be found naturally occurring along an elevation gradient in Northern Costa Rica. These two plant species, *Hamelia patens* and *Stachytarpheta frantzii*, can be monitored to determine what proportion of bee community utilizes them in order to understand their role in supporting bees temporally, across different elevations, and across time as rainfall patterns change. We conducted timed observations on *H. patens* and *S. franzii*, in June-July 2017 and 2018, and compared bee assemblages visiting these species to other shorter duration flowering shrub plant species in the study area, and to bee species assemblages collected using other active and passive capture methods. Although fewer bees overall were collected from the two continuous flowering shrub species, both plant species supported a species rich and consistent bee community. Rainfall patterns between the two years indicated that intra-annual variation in rainfall and less predictable rainfall patterns in the future may increase the importance of the continuous flowering shrub species. Ordination revealed elevation as an important factor in structuring the bee assemblage visiting the two continuous flowering species.

133 - The effect of nutrient growth media on microbial diversity cultured from Desmognathus fuscus skin

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The microbiota of amphibians has been implicated in the health of amphibian populations. Research in this area has spiked in response to the global amphibian crisis of the past 50 years suggesting that healthy and natural microbiota may help fend off potentially pathogenic microbes. Therefore, understanding the normal microbiome is important for conservation. Characterizing the microbiome of wildlife is challenging. The conditions in which samples are processed and cultured may affect the number and types of bacteria and fungi isolated from a particular organism. In this study, we obtained samples of *Desmognathus fuscus* from Beaman Park in Nashville, Tennessee and attempted to characterize the microbiome of the salamander skin. In particular, we are comparing the characteristics of the microbiome, when cultured on three media types, to see if they are redundant, yield significantly different patterns, or if each contributes to a better picture of the microbiome. The results suggest that all of the media types selectively favor gram negative bacteria and that the diversity of bacteria vary significantly from each media type. By using three different media types to culture the cutaneous microbes, we have a good understanding of the diversity of the microbiota of this population of *D. fuscus* and have an efficient technique to characterize the microbiota of additional populations or different species.

134 - Testing for trade-offs in varying plant defense strategies

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Chemical defenses in leaves can deter leaf herbivores. However, leaf chemical defenses are not the only defenses plants have against antagonists. Chemical defenses can also be found in flowers, and some plants rely on indirect defenses such as extrafloral nectaries (EFNs) to attract predators of herbivores. Each of these types of defenses can effectively prevent herbivory under some conditions, but they also each have physiological and/or ecological costs. It is therefore likely that there are trade-offs between defenses that will change which defense type is most efficient under varying environmental conditions. To test this, we completed two experiments using *Chamaecrista fasciculata*, which has condensed tannins in both leaves and flowers and uses EFNs to attract ant protectors. First, we completed a survey across a wide range of latitudes to look for patterns in plant defense. We found higher concentrations of leaf defenses at low latitudes, while EFNs were larger at high latitudes, suggesting a trade-off between chemical and indirect leaf defenses. Flower defenses were stable across all latitudes, perhaps because the reproductive importance of flowers necessitates their consistent defense. In our second experiment, we grew plants in a greenhouse with varying water and nutrient levels, then measured defenses. EFNs were larger and produced more nectar as a reward to ant protectors under high water and high nutrient conditions. Chemical defenses were also affected by water and nutrient levels. Taken together, the results of our two experiments suggest that plant defenses of all types are resource-limited, but that the geographic patterns seen in the field are driven by more than just resource availability. There may be strong trade-offs between defense types dependent on local genotypes or based on other environmental characteristics, such as the severity of herbivory or presence of ants.

135 - Translating museum archive science to studies of free-ranging wildlife: clinical assessment of bone density in the common bottlenose dolphin, Tursiops truncatus

James Powell, Deborah Duffield

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Common bottlenose dolphins, *Tursiops truncatus*, are utilized as indicators of ecosystem health in long-term research projects both through post-mortem evaluation of stranded or beach cast individuals and capture-release health assessments. To establish bone density as a health and life history parameter for the bottlenose dolphin, a primary target skeletal site in the radius of the dolphin pectoral flipper was comprehensively defined and a normative reference dataset was developed for the species. Bone mineral density (BMD) was measured in radii from 280 dolphins using dual-energy x-ray absorptiometry (DXA). The BMD distribution pattern throughout the radius was analyzed and a

single region of interest (ROI) was selected that had a high correlation to the density of the overall bone (R^2=0.98). To facilitate application to live animals and circumvent limitations in traditional radiographic bone density assessment, a custom quantitative ultrasound device and protocols were developed. Traditional methods for bone density measurement, such as DXA, utilize radiographic (x-ray) scanners that have limited potential in open-water field settings due to inherent limitations of access, regulation, and the radiographic nature of the technology. Alternatively, quantitative ultrasound is portable, non-invasive, and does not expose patients or technicians to radiation, thus making it an ideal diagnostic tool for field applications. In laboratory measurements on disarticulated flippers collected from beach cast dolphins, a strong correlation was established between bone density as measured with x-ray and quantitative ultrasound (R^2=0.93). Initial trials to develop clinical protocols and demonstrate the ultrasonic technique as truly non-invasive were conducted on managed care dolphins under veterinary supervision. Successful assessments were subsequently conducted to ultrasonically assess BMD in live, free-ranging dolphins during capture-release health assessments. Development of this technology enables assessment of dolphin bone tissue to become part of the armamentarium of researchers and veterinarians and additionally broadens the understanding of dolphin and overall ecosystem health.

136 - Estimating taxonomic diversity using growth profiles and stinger morphology of 34 million year old stingrays from North Dakota

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Freshwater stingrays used to inhabit the United States and Canada during very warm times in geologic record. No stingray material has been recorded from the northern part of the United States for the last 33 million years. We are interested in the freshwater stingrays that lived just prior to the climatic cooling that changed the area of what is now the Great Plains 33 million years ago. Our goal was to estimate alpha diversity of stingrays from a fluvial fossil deposit that existed 34 million years ago. Fossil elements of stingrays are represented by their individual vertebral centra, stingers, and teeth. No complete specimens have been identified. We examined 36 isolated vertebral centra and estimated from the number of growth cessation marks on each centrum. Centrum radial distance (mm) was measured from the notochord foramen to each annulus and plotted. For stingers, stingers were described morphologically and stinger thickness and median ridge thickness (mm) was measured for each specimen. Chronological ages ranged from 0 to 8 years old with two significantly distinct growth profiles; small and large profiles. There were three morphotypes of stingers. Measurements of stinger median ridge thickness indicated there were two small morphotypes and one significantly larger morphotype. Our data suggest there were three taxa of stingrays that lived in the river channels of North Dakota 33 million years ago. Two taxa were small and one taxon was somewhat larger. Our next goal is to determine whether there are three distinct morphologies in the vertebral centra. Our research indicates that diversity of freshwater stingrays was higher than expected. Climatic cooling may have caused regional extinctions of freshwater stingrays because freshwater stingrays are found in tropical and subtropical areas today.

137 - Investigating the physicochemical niche of macrophyte Podostemum ceratophyllum Michx. (Hornleaf riverweed)

Samuel Canfield, James Wood

West Liberty University, West Liberty, WV

Podostemum ceratophyllum Michx. (Podostemaceae), henceforth known as *Podostemum*, is an angiosperm that inhabits mid-order montane and piedmont rivers in eastern North America. *Podostemum* is considered a “foundation species” because the plant strongly influences stream ecosystems by increasing substrate habitat heterogeneity for macroinvertebrates and fishes, sequestering water column nutrients, and contributing to food webs. *Podostemum*’s historical distribution encompassed a majority of the eastern United States from Maine down to Georgia and westward into Oklahoma. Currently, NatureServe reports *Podostemum* is critically imperiled to vulnerable (S1 to S3) in 15 of the 26 states it occurs in and seven state populations are unranked/under review. Stream degradation, including excessive sedimentation, hydrological alterations, and acute water chemistry fluctuations are postulated to impact *Podostemum*’s survival negatively; however, the physical and chemical environment that supports *Podostemum* requires

additional investigation to improve habitat degradation evaluations. In response, the primary study objective was to investigate *Podostemum*'s physicochemical associations to further elucidate niche requirements. *Podostemum* percent cover and stem length, as well as eleven physicochemical characteristics, were collected from fourteen sites in nine West Virginia (S1) mid-order rivers. These data were analyzed using Markov Chain Monte Carlo (R package: MCMCglmm) hierarchical modeling to incorporate sampling site as a grouping variable. Percent cover and stem length exhibited significant positive and negative associations with substrate size and canopy cover, respectively. Additionally, both percent cover and stem length were positively correlated with the interaction between flow velocity and water depth. Relationships between *Podostemum* and chemical predictors were inconclusive due to low sample sizes. Subsequently, a multifaceted long-term study incorporating physicochemical, herbivory, and land use predictors would further benefit *Podostemum* repatriation efforts.

138 - Defining broad scale habitat associates for an imperiled crayfish, Cambarus veteranus

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The Guyandotte River Crayfish (*Cambarus veteranus*) is a federally protected species of crayfish known from two streams within the Upper Guyandotte river basin in West Virginia. The entire known range of *C. veteranus* is represented by two disjunct populations and as such an assessment of broad and fine-scale habitat associates is warranted. The goal of this study was to utilize maximum entropy modelling (Maxent) to predict broad scale habitat associates for *C. veteranus* and to create a map of detection probability for every stream reach within the basin. Occurrence records from a 2015 survey of the Upper Guyandotte were used to create the models. Environmental variables used in the models included stream order, elevation, landcover, and presence of mining activities. The mean area under the receiver operating characteristic curve (AUC) was 0.975 showing the model had high predictive accuracy. Stream order had the highest variable contribution and permutation importance. The model predicted that *C. veteranus* prefers 4th and 5th order streams. Ground validation will be completed to further test the accuracy of the models.

139 - Examining the presence and abundance of microplastics in the Cumberland River in Nashville, TN.

Lina Said, Matthew Heard

Belmont University, Nashville, TN

Urban rivers are facing a growing threat from microplastic pollution. However, there has been little research done in most rivers to examine how the presence and abundance of microplastics varies over time. Here, we examined how microplastic pollution levels varied over a two-month period in the Cumberland River in Nashville, TN. In addition, we examined whether sites upstream and downstream of wastewater treatment plants, which are potential sources of microplastics had different levels of pollution. We found that every water sample we collected across our sites had microplastics present. In addition, we found significantly higher levels of microplastics downstream of wastewater treatment plants. These findings indicate that microplastics are a threat in the Cumberland River. This finding is concerning because the Cumberland is a diverse ecosystem and because it provides drinking for the city of Nashville, TN.

140 - Assessing fish movements in a culvert-bisected stream reach using instream stationary antennas

Will Commins, Bill Ensign

Kennesaw State University, Kennesaw, GA

Populations of riverine fishes can be divided into stationary (stayers) and mobile (movers) components. The importance of movement for many stream fishes is supported by reductions in fish diversity within watersheds where movement barriers have been introduced. In this study we investigate the effects that a movement barrier has on the proportions of movers in a stream fish community. This study took place between April 18, 2018 and November 10, 2018 in a 600-meter

stream reach of Raccoon Creek in Paulding County, Georgia. The stream reach consisted of a 300-meter reach bisected by a culvert and a 300-meter reach of unimpeded stream. We used 12mm passive integrated transponder (PIT) tags and four instream stationary antennas to monitor the movements of six species of fish (428 individuals). Multiple detections of an individual at the same antenna were binned at 6 hour intervals and considered a single detection event. There were 12,951 detection events resulting in the detection of 248 of the 428 individuals (57.9%). The proportion of tagged individuals detected by species ranged from 46.6% (*Lepomis auritus*) to 90% (*Hypentelium etowanum*). From June 10th, 2018 through November 10th, 2018 147 movements were detected. During this time, 22% of tagged fishes made movements of 150-meters or greater, 1.6% made a 300-meter movement through the reach bisected by the culvert, and 9.6% made a 300-meter movement through the non-impeded reach. The mobile component of the populations ranged from 12% (*Moxostoma duquesnei*) to 35% (*H. etowanum*). In addition to the descriptive analysis, we have developed a multi-state model to determine the likelihood of movement for each species. The results from this study indicate that an array of instream stationary antennas can be used to examine the differential movements of PIT tagged fishes and in turn potentially inform conservation and management decisions.

141 - Ecological Impacts of a Recetly Dammed River in the Indian Himalayas

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The Eastern Himalayan region is a biodiversity hotspot and is the source of the eight largest rivers of Asia and home to about 20% of humanity. The Teesta River is 310km long with multiple sources primarily from the Zemu and Teesta Khangse glaciers of mount Khangchendzonga and drains an area of 12,540 km^2. Very little is known about the impacts of rapidly increasing ecological degradation in the region. This study was carried out in the reservoir of the recently constructed Rambi dam in order to assess its impact as a driver of ecological change. A rubber boat and high-resolution GPS chart plotter (30cm resolution) were used to map the river upstream of the Rambi dam. Three transects, parallel to the riverbank were run and depth was recorded at regular intervals to develop a bathymetric map. Land cover loss post-damming was calculated in ArcGIS using classification and time series analyses of satellite imagery from 2011 (pre-dam) and 2018 (post-dam). Bathymetric analysis showed the minimum depth of the Teesta is 0.2m over rocky ripples and the maximum depth along the river transects is 23.8m and the average depth is 7.4m. Photogrammetric analyses showed that almost 2km^2 of land has been inundated due to the dam, which has killed 3,720 trees. The dam has transformed the Teesta from a lotic to a near-lentic system, disturbed flood regimes, sediment deposition patterns, and altered the river-scape by permanently inundating riparian habitats. Ecological effects such as forest cover loss and reduced fish abundance have been reported, but not researched yet. This study is the first attempt to create a baseline survey especially along the impacted reaches of the Teesta River. More research is needed to develop management guidelines to restore the ecological function of this unique Himalayan ecosystem.

142 - The Effects of Local Riparian Zone and Streambed Sediment on the Abundance, Diversity and Distribution of Freshwater Fishes in Piedmont Streams of South Carolina

Scott Finney, Dennis Haney, Greg Lewis

Furman University, Greenville, SC

Previous research has revealed that dominant watershed land cover types (e.g., pasture, forest, agriculture) do not adequately explain the observed trends in diversity, abundance and distribution of freshwater fish populations in rural habitats. However, most studies investigate the effects of land cover at very large spatial scales, but fish are mobile enough that they may be selecting habitats at a much smaller spatial scale. As such, we conducted a study to see if extremely localized changes in riparian zones and habitat quality better explain distribution patterns of stream fishes in the South Carolina Piedmont. At each location, data were collected in two different 60 m reaches of the same streams, approximately 100 m apart, with each reach containing a differing extent of local riparian cover. We collected fish, measured aspects of the riparian zone immediately adjacent to the stream, did a grain size analysis of streambed sediment and collected geomorphology, water chemistry and land cover data. We hypothesized that fishes would be more abundant, and populations more diverse, in reaches with riparian zones containing more ground and canopy cover, and where sediment composition was more homogenous. Results demonstrated no significant effects of local

riparian cover, likely because of the limited scope of our measurements. We did see an unexpected positive correlation between Simpson's Diversity and percent agricultural and pasture landcover, and a negative correlation between percent forest cover and Simpson's diversity, however. This may be explained, in part, by the negative correlations between percent forest cover and average sediment size and skewing, as well as the positive correlations between sediment skewing with percent crop cover. Thus, initial results indicate that local riparian vegetation may not be as influential as streambed sediment composition in structuring freshwater fish assemblages.

143 - Identifying Habitat Utilization and Movement of a Federally Endangered Narrow Endemic Crayfish Species, Cambarus veteranus (Guyandotte River crayfish) via Radio Telemetry

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The movement and habitat selection/utilization of the federally endangered crayfish *Cambarus veteranus* (Guyandotte River Crayfish) was investigated via radio telemetry. This project was initiated to determine the feasibility and success of tracking an endangered Appalachian crayfish and to assist in the design of our future radio telemetry projects. Tracking occurred in the Clear Fork drainage of the Guyandotte River, Wyoming County, West Virginia, during the summer of 2018. Transmitters weighing 1.2 g were affixed to the ventral side of the right chela of five *C. veteranus* individuals (1 form I male/2 form II males/2 females) and released back to their point of capture. Individuals were tracked three times daily for three consecutive days followed by a 6 day non-interaction period when individuals were not monitored. Following the non-interaction period, animals were then tracked once daily every 2 – 3 days for approximately 4 weeks. When an individual was located, the total distance traveled since it was last located and the micro/macro habitat type it was found in was noted. Water depth, water temperature, current velocity, and distance to nearest bank were also noted at each individual's position. Our preliminary results provided interesting insight about the ecology and movement of *C. veteranus* and showed far greater movement for *C. veteranus* than expected, with a single crayfish moving over 480 m. Differences in movement behavior was observed between tracked males and females with males moving more frequently and traveling further than females. Although nighttime tracking was not completed, it was assumed that the majority of movement occurred during the night. Of the five crayfish tracked, four were retrieved at the completion of the study. No crayfish appeared to be harmed or impeded by the transmitters.

144 - Rangewide conservation assessment and analysis of land use impact on Cambarus spicatus (Broad River Spiny Crayfish)

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The Broad River Spiny crayfish, *Cambarus spicatus*, is a rare species found in disjunct drainages in the Broad River watershed in North Carolina and South Carolina. In recent years, land around streams with apparently suitable habitat has been disturbed by urban and agricultural development. In the summers of 2017 and 2018, the West Liberty University Crayfish Conservation Laboratory (WLUCCL) surveyed 147 sites in the following watersheds in South Carolina: Broad, Catawba, Enoree, Pacolet, Saluda, and Tyger. ArcMap and the National Land Cover Database 2011 were utilized to obtain land use types from three hundred diameter buffer zones centered on each of the sites sampled. Of 147 sites, *C. spicatus* was present at five and absent at 142. A Zero-inflated negative binomial regression (ZINB) was the first statistical analysis chosen because of a large amount of negative data in the dataset. Secondly, a nonmetric multidimensional scale (NMDS) model was created to better observe presence and absence relationships *C. spicatus* had with each land cover type. ZINB results were insignificant and showed that land use alone did not predict the presence or absence of a rare crayfish. The NMDS model showed that the presence of *C. spicatus* was associated with three major groups of land cover types. At most sites where *C. spicatus* was present, "Forest" land cover type was present within the buffer zone. However, a large portion of

captures occurred in the land cover types, "Crop" and "Pasture". Future research, including a life history study, is needed to understand more about *C. spicatus* and what habitat and environmental conditions the species needs to thrive.

145 - Distribution and Genetic Diversity of Nabalus serpentarius and its Common Congener, N. trifoliolatus (Asteraceae)

Steven Ballou, Paige Murin, Jennifer Mandel

University of Memphis, Memphis, TN

Nabalus serpentarius (Pursch) Hooker, originally *Prenanthes serpentaria* also known as Lion's Foot, is a perennial, herbaceous plant that typically inhabits recently disturbed areas, sand plains, grasslands, and heathlands. It is native to the Eastern portion of the United States and in Massachusetts it is listed as endangered. On the island of Nantucket, there are known populations of *N. serpentarius* and a strong conservation effort making the island an ideal location to conduct a population genetic study to better understand distribution of alleles within and among populations and build a conservation plan to protect the greatest diversity possible. To better understand the genetic diversity within *N. serpentarius* populations, a common (non-endangered), related species, *Nabalus trifoliolatus*, was similarly studied. The purpose of this common congener is to elucidate the likely structure of populations of a non-endangered *Nabalus*. Leaf tissue was collected from at least 20 individuals from four populations of *N. serpentarius* and five populations of *N. trifoliolatus*. From these samples, DNA was extracted and PCR was performed on a test set of samples from each species using primers for 17 microsatellite loci developed for a species in the same tribe, *Taraxacum kok-saghyz* (Russian dandelion). Eleven of the primers successfully produced an amplicon of similar size to the dandelion sample. These primers were used to amplify corresponding DNA fragments in all DNA extracted. The resulting data will be used for genetic analysis and assessment of population structure and diversity with the intent to inform conservation agencies on the island of Nantucket which populations need the greatest attention.

146 - Genetic Structure as a Response to Anthropogenic and Extreme Weather Disturbances of a Coastal Dune Dwelling Spider, Arctosa sanctaerosae

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The development of Northern Gulf of Mexico coastline over the last century has fragmented the habitat and the sprawl of large cities has created potential barriers to gene flow. In addition to human pressures, naturally occurring extreme environmental perturbations (catastrophes) have a profound effect on the persistence time of populations and species, but there have been few studies that look at the role of hurricanes as a form of disturbance regime and their effects on population dynamics. The burrowing wolf spider, *Arctosa sanctaerosae*, Lycosidae, is endemic to the secondary dunes of the the Northern Gulf of Mexico and is threatened by these factors. We examined the effects of severe tropical storms on spider density and described its genetic diversity and structure. We found a significant impact of storms and related this to ecological factors including the height of the dunes and density of vegetation. Additionally, the historically single, contiguous population has been subdivided into 5 population subgroups and the isolates reduced in size and gene flow. Based on these results we propose conservation and restoration strategies in the face in increasing anthropogenic and environmental pressures.

147 - Cryptic Hybridization in Southern Appalachian Pitcher Plants (Sarracenia spp.)

Jennifer Rhode Ward, Rebecca Hale, Caroline Kennedy

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Eleven species of the carnivorous group *Sarracenia* (pitcher plants; Sarraceniaceae) are distributed throughout the southeastern United States. Unless separated by allopatry, overlapping flower phenologies foster hybridization between congeners. Two pitcher plant species endemic to western North Carolina and northwestern South Carolina are *S. purpurea* var. *montana* (mountain purple pitcher plant) and *S. jonesii* (mountain sweet pitcher plant); the former is a candidate for listing, while the latter is federally endangered. Phenotypically intermediate plants often co-occur in sites with

these two parental species. We used microsatellite loci to detect hybridization in ambiguous morphotypes, and to confirm the species identity of plants in a *Sarracenia rubra* (sweet pitcher plant) population. Molecular genetic techniques were able to estimate hybrid indices for individuals, to detect introgression in plants that appeared to be of parental stock, and to clarify the management status of a population previously identified as *S. jonesii*. We are now working to apply previously-developed pitcher morphology measures to correlate leaf traits with genetic composition, as a tool for more efficient field identification.

148 - The Tennessee Plant Conservation Alliance: Preventing the local extinction of Tennessee's rare plants through collaborative partnership

Cooper Breeden

Tennessee Plant Conservation Alliance, Clarksville, TN; Center of Excellence for Field Biology, Austin Peay State University, Clarksville, TN; Southeastern Grasslands Initiative, Clarksville, TN

The Tennessee Plant Conservation Alliance (TPCA) is a collaborative network that connects state and federal agencies, university researchers, botanical gardens, nurseries, nonprofits, volunteers, and more to facilitate the conservation of rare plants and communities across the state. With over 500 rare plants in Tennessee, such a coalition of organizations and individuals dedicated to the conservation of Tennessee's rare plants is essential. This is a new effort in Tennessee, but it is modeled after programs in other regions of the country that have experienced decades of success. In its inaugural planning meeting this winter, the TPCA met to discuss conservation priorities and worked together to establish an initial list of priority projects. The conservation measures and partners involved for each project vary depending on the specific needs of the species. One such example is *Trifolium calcaricum*. The work that has been done on this species serves as a model for how TPCA partners can collaborate on highly effective and impactful projects. This particular project has involved the cooperation of state agencies, civic groups, nurseries, and all of it has been led by a dedicated, passionate volunteer. Other projects include a variety of different *in situ* and *ex situ* conservation measures. In some cases, it will involve the harvesting of seeds of highly imperiled populations such as *Helianthus verticillatus*, which will then be propagated and introduced into protected areas. Others may involve species monitoring projects to learn more about the rare species in question before determining which conservation efforts may be most appropriate.

149 - Induction of caulogenesis in a critically endangered African violet (S. rupicola B.L. Burtt) for production of new plants

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The *in vitr*o propagation of plants through caulogenesis is a promising method for the production of plants in species that are endangered, commercially valuable, and/or otherwise difficult to propagate through traditional horticultural methods. Leaf and petiole explants of critically endangered African violets (*Saintpaulia rupicola* B.L. Burtt) were cultured on a chemically defined medium that was supplemented with either 2.0μM, 5.0μM, or 8.0μM thidiazuron (TDZ). These concentrations were used for either an induction medium that the explants remained on throughout development, or an induction medium, that the explants remained on for 10 days, followed by a basal medium. None of the petiole explants grew or developed any organs while in culture for 12 weeks. Leaf explants, from all treatments, developed callus from which adventitious shoots differentiated. Callus isolated from the leaf explants was placed on a basal medium and differentiated to form adventitious shoots. Isolated shoots were able to grow in size and develop further when planted on a basal medium or directly on soil. This provided evidence that TDZ may be used for the induction of adventitious shoot growth and that these concentrations of TDZ do not induce somatic embryogenesis in *S. rupicola*. The methods used are useful in the mass production of new *S. rupicola* plants for the purposes of conservation *ex situ* and *in situ*.

150 - In Situ conservation physiology of the rare white fringeless orchid

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Platanthera integrilabia (Correll) Luer (white fringeless orchid) is a rare terrestrial orchid species of the southeastern U.S. that is listed as threatened under the Endangered Species Act. Efforts to conserve P. integrilabia by academic, institutional, and agency partners include the establishment of new populations to reduce overall extinction risks of this species. The success of such efforts could be enhanced by furthering understanding of the habitat suitability of this species. Well-designed and cooperative transplantation plans that involve locating transplants across a range of abiotic and biotic conditions afford an opportunity to advance such understanding. I am conducted an experiment during the 2018 growing season to assess the main effects and interaction of light availability and herbivore protection on the success of ~10 P. integrilabia individuals transplanted into the Virgin Falls Natural Area (White Co., TN). Specifically, I investigated the influence of increased light availability associated with common local forest management practices (i.e., canopy thinning, prescribed burning) and protection from white-tailed deer (Oedocoileus virginianus), which are overabundant in many local natural areas, on individual- and population-level growth, reproduction, and underlying physiology of transplants as fitness measures. Results show that individuals were able to acclimate to new light regimes over the course of one growing season (via light response curve measures), indicating the potential role of local adaptations when considering rare species management, and that there were insignificant differences in herbivory extent among various exclosure types. These findings will be used to inform future transplantation efforts following ex situ propagation and subsequent site management, as well as the management of habitat housing naturally occurring P. integrilabia populations.

151 - Longleaf Pine seedling survival rate in response to environmental factors

David McCollum

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Blackwater Ecological Preserve (BEP) is a 319-acre area of land that is the northernmost occurrence of a natural Long Leaf Pine (LLP) ecosystem. A twenty-two-acre area of the BEP that was a loblolly pine plantation was clear cut in winter of 2017. There was a prescribed burn after harvest to reduce competition. LLP seedlings were planted at a density of 435 per acre. To determine LLP seedling survival rate, 40 randomized 10 x 10 m plots were established in fall 2018 in the twenty-two-acre area. Seedling root collar diameter was measured to determine vigor and survival was compared to soil nutrients, elevation, and competition. One year after planting, the survival rate was determined to be 22%. There was considerable variation in survival across the planted site and it appears to be related to elevation and moisture level. There was no correlation observed between seedling survival and the young growth of woody competition. However, dense patches of loblolly pines limited survival. Seedlings that were present on a slope were observed to be larger in diameter and healthier. Genetic differences between the seedlings is a factor that could affect size differences.

152 - Climatic change and parental care in wild birds

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It is now widely accepted that climate change has affected the seasonal phenology of many taxa, including that of wild birds, yet little is known about how these changes affect individual fitness, and, thus, the strength and shape of selection on breeding date. A recent observational analysis of a long-term dataset assessing climate-induced effects on avian life histories and offspring development revealed numerous changes in the biology of breeding birds over recent decades, with selection on breeding date varying among years and with ecological conditions. While long-term observations are critical, much of the evidence for effects of climate change to date is derived ultimately from correlational studies, whereas inferences of causation require experimentation. Here, we assess effects of increased environmental temperature during incubation on posthatching development, nestling begging and parental care, and nestling physiology in two cavity-nesting songbirds, the Carolina wren and prothonotary warbler. We heated experimental nests only during incubation,

increasing nest-cavity temperature by ca. 1 °C. This reduced the length of the incubation and nestling periods, and reduced fledging success in prothonotary warblers, while nestling Carolina wrens had similar fledging success but reduced body condition in response to increased temperature. Increased nest-cavity temperature during incubation also reduced posthatching begging by nestlings generally and parental care within Carolina wrens specifically, suggesting potential mechanisms generating these carry-over effects. Nestling hematocrit also varied non-linearly with environmental temperature. Offspring body mass, hematocrit, and fledging age are often predictive of post-fledging survival and recruitment. Thus, our results suggest that increasing temperatures may affect fitness in wild populations in species-specific ways, and induce life-history changes including the classic trade-off parents face between the size and number of offspring.

153 - Variation in Eggshell Coloration in Eastern Bluebirds (Sialia sialis)

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The broad array of color represented in avian eggshells has promoted extensive investigations into its adaptive significance, especially when the chromaticity seems counterproductive to natural selection as seen in conspicuous blue-green pigments. Eggshell coloration is a female-specific trait that may affect the recognition of her eggs versus con-specific brood parasites and function as a post-mating signal to reflect her fitness. In Eastern Bluebirds (*Sialia sialis*), the blue-green color of the eggs is attributed to the deposition of a organic pigment (biliverdin), an energetically expensive antioxidant, and allocating this valuable resource to their eggs implies selective pressure. For a female bird to recognize her eggs from a con-specific brood parasite, we would expect for her to lay consistently colored eggs, and since biliverdin is a limited resource, healthier females are projected to lay darker eggs. To determine the function of eggshell coloration, we quantified the blue-green chroma (BGC) of 1233 eggs from an established population of Eastern Bluebirds in Jonesboro, Arkansas and used this color value to examine interclutch variability between the first two broods of each nesting season for three consecutive years. We tested whether year, clutch initiation date, or clutch size best explained the variation of BGC within the population. We then compared a subset of banded females that laid clutches containing the darkest and lightest quartile of eggs in our population to typical indicators of female condition to determine if egg coloration is an honest signal of her quality. Our results contradict previous expectations that biliverdin is a limited pigment and that egg color functions as a signal of female condition.

154 - Ontogenetic variation of nodosaurid armored dinosaurs (Nodosauridae, Ankylosauria) with description of a new juvenile specimen from the Lower Campanian Mooreville Chalk of Alabama

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Late Cretaceous dinosaur remains are rare in Appalachia, relative to Laramidian localities. Armored dinosaurs, especially juveniles, tend to be uncommon in fossil assemblages globally. A previously undescribed specimen of nodosaurid ankylosaur from Alabama includes juvenile elements, and is, arguably, the most complete such specimen from Appalachia to date. Although original provenance data is lost, it was most likely recovered from the Lower Campanian Mooreville Chalk (based largely on nannofossil correlations), a marine deposit in south-central Alabama. The specimen includes a basicranium, partial maxilla and right dentary, scapular fragments, partial right ilium, the left half of a cervical neural arch, and vertebral centra from the sacral through caudal regions. Juvenile characters include an open basioccipital-basisphenoid suture, incipient osteodermal sculpturing on the mandible, and a lack of neurocentral fusion. The relatively high crown on the teeth may be a basal or juvenile character. The antorbital fenestra, a remnant of which is visible on the maxilla, has not been described previously in ankylosaurs (its closure in adults is synapomorphic for the clade). There is little dorsoventral flexion to the ilium, a condition more similar to adult nodosaurids than juvenile ankylosaurids. One ontogenetically younger specimen (~77% smaller), from the Albian Paw Paw Formation of Texas, demonstrates a more ventrally deflected preacetabular process of the ilium; however, this trend of a progressively flatter ilium is consistent with the evolutionary history of the unique ankylosaurian pelvis. So, this character may be ontogenetically or taxonomically variable. Further work on this specimen will include histologically sectioning the femur for an estimated age at death, which will allow more accurate ontogenetic comparison to other specimens. Additional

ankylosaur material is known from Alabama, although it is fragmentary, consisting of isolated limb elements, osteoderms, phalanges, and vertebrae. Additional nodosaurid material from Alabama would likely have considerable ontogenetic and paleogeographic significance.

155 - Differential Gene Expression as a Tool for Assessing Homology among Extrafloral Nectaries in Passiflora L. (Passifloraceae)

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Extrafloral nectaries (EFNs) are sugar-producing structures that provide rewards for insects in exchange for defense against herbivory. These structures are remarkably diverse across angiosperms, evolving independently in many lineages. Passifloraceae, known as the passionflowers, is an excellent lineage within with to study the evolution of EFNs due to high morphological diversity, unique distributional patterns, and genetic proximity to one another. One question of particular interest involves identification of precursor structures for EFNs in Passifloraceae. This family belongs to the salicoid lineage, which exhibits both secretory leaf teeth and EFNs, suggesting that there may be homology at a genetic level among these structures. A comparative transcriptomic study identified 12 genes with significant differential expression in EFN structures using one species of *Passiflora* and one species of *Adenia*. In the present study, gene expression patterns in four of these candidate genes, *SHI*, *B3-1*, *B3-2*, and *NAC,* are examined in *Passiflora morifolia, P. incarnata,* and *P. boenderi*. Real Time qPCR was utilized to show differential expression between each candidate gene at early developmental stages of EFN, non-EFN, and leaf teeth. Results indicate significant upregulation of candidate genes *SHI* and *NAC* in all EFN and marginal teeth tissue for the three species. However, *B3-1* and *B3-2* show unique patterns of expression when examined across the three species. *Passiflora morifolia* and *P. incarnata* petiole EFNs exhibit upregulation, but abaxial laminar nectaries in *P. boenderi* do not, instead showing greater expression along the margin of the lamina. These latter two genes may be involved in margin development rather than in specification of EFNs directly. The present data suggest similar genetic mechanisms may be involved in the formation of leaf teeth and EFNs in *Passiflora,* at least with respect to *SHI* and *NAC*. Additional candidate genes identified will be evaluated for their role in future studies.

157 - Bacterial Relics from the Pangaea Super-continent?

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Deep subsurface microorganisms are now estimated to constitute ~10% of our planet's total biomass and are found to contain a large fraction of yet characterized biological diversity. Many of these microorganisms have access to extremely limited energy sources, resulting in estimated generation times that exceed decades. *"Candidatus* Desulforudis audaxviator" is an uncultured lineage of the bacterial phylum Firmicutes that was originally discovered in deep rock fracture fluids in South Africa. Here we report first *D. audaxviator* genomes from the deep subsurface of multiple continents: Africa, North America and Eurasia; and 126 genomes obtained from individual cells were sequenced. Unexpectedly, all genomes shared >99% average nucleotide identity and had similar gene content. Multiple lines of evidence suggest that *D. audaxviator* are metabolically active at these sites. We found no evidence for cross-continental dispersal or contamination, indicating that minimal evolution took place in the studied *D. audaxviator* populations since their separation, possibly proceeding the breakup of Pangaea ~175 million years ago. In addition to long generation times, high fidelity DNA replication and efficient repair mechanisms appear the most plausible causes leading to the stalled evolution of *D. audaxviator* over geological time scales. *D. audaxviator* presents a stark contrast to the current model organisms in microbial evolutionary studies, which are found to develop adaptive traits over ~10^9-fold shorter periods of time.

158 - Does asexuality confer a short-term evolutionary advantage? The case of the widespread apomictic fern *Myriopteris gracilis* (Pteridaceae).

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Although asexual reproduction is generally seen as an evolutionary dead end, this strategy appears to have provided a short-term benefit in some taxa. For example, a short-term advantage to asexuality has been considered an important component of "geographical parthenogenesis", a common pattern in which asexual taxa display a wider distribution than their sexual relatives. However, these seemingly broad distributions may be an illusion created by multiple, morphologically cryptic, asexual lineages that each occupy a relatively small area. *Myriopteris gracilis* is a North American asexual triploid fern species with a particularly large range. We ask: 1) is *M. gracilis* exclusively asexual? and 2) does *M. gracilis* comprise a single wide-ranging asexual lineage, or multiple, more geographically restricted lineages? Sexuality was assessed by counting spores/sporangium in 606 specimens from across the species range, and lineage structure was assessed with both plastid DNA sequence and Genotyping By Sequencing (GBS) SNP datasets. Spore counting identified no sexual populations, establishing that the sexual diploid progenitor of *M. gracilis* is either extinct or so limited in its distribution that it does not contribute to the extensive range of the species. The plastid data estimated the crown age of *M. gracilis* at ca. 2.5 mya and identified two morphologically distinctive lineages exhibiting minimal geographic overlap. These groups were further subdivided by the GBS data, revealing at least seven asexual lineages of varying distributions, none of which approached the total size of *M. gracilis'* range. The total *M. gracilis* distribution therefore overstates the success of any one asexual lineage, and by extension, the potential short-term benefit of asexual reproduction in this species.

159 - A game theory approach to understanding the evolution of cooperative behavior

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Evolutionary theory is based on the conflict that arises when certain heritable variants out-compete others. Given this foundational conflict, a central question for evolutionary biologists concerns the presence of cooperation found throughout all levels of biological organization; from biochemical pathways to complex animal societies. Human behavior is often distinguished from other animal behavior by the presence of acts of cooperative behavior called altruism. Altruism is a cooperative act that penalizes the actor for actions that benefit the recipient. Any other form of cooperation, one that does not penalize the actor, is formally not considered altruistic. How can costly altruistic behavior evolve? This question was the basis for development of a web application tool incorporating a game theory model to investigate conditions affecting cooperative behavior. The game theory model described as Prisoner's Dilemma incorporates acts of cooperation and non-cooperation (defection). Computer simulations of Prisoner's Dilemma were developed and online applications were administered for five semesters at Georgia Gwinnett College, using two simulation models referred to as Random and Nonrandom. Data collected from simulation runs were used to evaluate the effect of environment on student cooperative behavior and actively engage students in concepts associated with the evolution of cooperation and game theory. Results from student game play suggest group environment, as defined by the simulation models, plays a significant role in the likelihood of observing cooperative behavior.

160 - The status of violet (Violaceae) taxonomy in the southeastern U.S. flora

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Since 2012, taxonomic studies on violets (Violaceae) of eastern North America in our lab have focused heavily on taxa and populations in the central Appalachian and mid-Atlantic region, and most recently have extended to the southern Atlantic and Gulf Coastal Plains. Integrative investigations have examined numerous macromorphological traits over the plant body, reproductive biology, microhabitat specificity manifested in soil variables, and geographic distribution, using multi-year field studies, local and regional herbarium collections, common garden cultivation, lab approaches and (in

limited cases) microsatellite differentiation. We have applied the Unified Species Concept as an objective filter on diverse lines of evidence to delineate species and detect de novo hybrids. While genetic evidence has been restricted due to available funds, the other approaches have been applied with sufficient sampling intensity to most species complexes to permit confident taxonomic conclusions or generate reasonable working hypotheses. Alan Weakley's 2015 flora of the southeastern U.S. recognized 44 violet taxa: 1 *Cubelium* species, 1 *Pombalia* species, and 37 *Viola* species, 4 varieties, and 1 cultivar. Our current studies recognize 58 taxa: the *Cubelium* and *Pombalia*, plus a second *Pombalia* waif, and 52 *Viola* species, 2 varieties, and the cultivar (a 32% increase in violet taxa, mostly in the Acaulescent Blue violets). In *Viola*, 3 infraspecific taxa should be elevated to species rank, 8 species require resurrection from synonymy, 4 are new species, 1 variety should be retained, and a species name and varietal name must be replaced. Four broadly delimited polymorphic "species" in the Acaulescent Blue violets harbor multiple taxa requiring further study, most or all of which probably represent additional species awaiting description.

161 - Morphological challenges in identification of taxa in the Rhododendron viscosum group (Ericaceae).

Charles Horn

Newberry College, Newberry, SC

The genus *Rhododendron* consists of about 21 species in North America, most of which are naturally occurring in the southeast. One species complex, *R. viscosum*, has been variously recognized to consist of up to three species including the segregates *R. serrulatum* and *R. oblongifolium*. In a monograph of the genus, Rehder (1921) recognized the three species and six varieties of *R. viscosum*, each separated by morphological features of the branches, leaves, winter buds, and corolla. Roane and Henry (1981) recognized the three species, but no varieties, noting distinction on features of branchlets, leaves, buds, calyx, and corolla. At the other end of the taxonomic spectrum, Kron (1993) suggested, through numerical analysis, that *R. viscosum* is a widespread species with much morphological variation. Most recently, Weakley (2015) has proposed recognition of two varieties of *R. viscosum*, var. *viscosum* and var. *serrulatum* based on bud scale and corolla features. Even though Rehder suggested a distinct geographical distribution for each of his recognized species, other authors have not agreed. To help develop a clear and stable taxonomy, field and molecular work will need to be combined along with herbarium work.

162 - Taxonomy of the Clematis viorna complex (Clematis subgenus viorna) of the southeastern United States.

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It has long been assumed that the flora of the southeastern United States has thoroughly been exploited through many phases of plant taxonomic discovery. Despite this notion, many new vascular plants species are frequently being discovered from biodiversity hotspots of high plant endemism. As expected, many of these discoveries constitute taxonomically complex genera that allude to biological relationships that remain to be resolved. This project reexamines the taxonomy of a sub-set of the North American *Clematis* subgenus *viorna*. Specifically, defined as the *Clematis viorna* complex, an artificially derived classification consisting of *Clematis viorna sensu stricto;* the synonymized historical taxa: *Clematis beadlei*, *Clematis flaccida*, *Clematis gattingeri*; and eight putative new allopatric taxa delimited by morphology and physiography. Extensive field work to voucher herbarium and living material has been completed over a two-year growing season for all named and potentially undescribed taxa within the complex. All accessions are grown in duplicate sets at the campuses of Austin Peay State University and Mt. Cuba Center. Living material is being utilized for studying phenetic and phenological characteristics and extensively photographed across all developmental stages. Morphometric analyzes utilized are multi-faceted in approach. ImageJ software is being used to take quantitative measurements of 20 floral and vegetative characters for 12 OTUs from digitized Herbarium Specimens. Stomatal densities per mm^2 and stomatal length have been counted and measured with SEM and compared across all taxa. The goal of this project is a re-circumscription of *Clematis viorna,* the resurrection of historical taxa from synonymy, and potential description of eight new species if supported by analyses.

163 - A New Rush Species Endemic to the Altamaha Grit of Georgia

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A new *Juncus* species (Juncaceae) is described from a two county area of the Altamaha grit, a sandstone formation in the Coastal Plain physiographic province of Georgia, U.S.A. This new species resembles other members of section Ozophyllum, but is readily distinguished by its annual life history, diminutive habit, and smaller capsules and tepals. The type locality is an area of geologic interest that supports a unique assemblage of rare and endemic to near-endemic plant species.

164 - Phylogeography and population genetics of Sandmyrtle (Kalmia buxifolia, Ericaceae)

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Sandmyrtle, *Kalmia buxifolia* (Bergius) Gift & Kron, exhibits a disjunct distribution in eastern North America. Extant populations occur in the New Jersey Pinelands (NJP), the Southern Appalachian Mountains (SAM), and the Sandhills/Cape Fear Arch (SCFA) region of the Carolinas. There is no present-day geographic connection between NJP and SCFA populations, and very little between the SAM and SCFA populations. Despite relatively close geographic proximity, the SAM and SCFA populations are dissimilar in terms of habitat; SAM populations typically occur on rock outcrops and SCFA populations occur in wet pinelands that are ecologically similar to the northern NJP populations. Individual plants also vary morphologically, with SAM and NJP plants tending to be somewhat mat-forming and SCFA plants tending to be taller and spindly. Over the last 150 years, experts have recognized between one (current consensus) and three species based on a combination of morphology and habitat. We developed microsatellite DNA markers for Sandmyrtle using an Illumina sequencing dataset, sampling from three populations representing the three main parts of the Sandmyrtle distribution. We then applied these markers to an additional eight populations in order to gain landscape-level insights into Sandmyrtle's genetic variability and structure, deviation from Hardy-Weinburg assumptions, and phylogeographic history. Our current dataset indicates that some populations differ significantly from others with regard to these characteristics. Additionally, SCFA and NJP populations are more genetically similar to each other overall, somewhat aligning with the taxonomic boundaries indicated by JK Small in the 1930s.

165 - A determination of berberine concentrations in commercially available Hydrastis canadensis herbal supplements using HPLC.

Claire Brewer, Timothy Trott

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Berberine, the active alkaloid present in *Hydrastis canadensis* (commonly known as Goldenseal), has historically been used to treat a range of infections and ailments, including colds, influenza, vaginitis and diabetes. Berberine is naturally produced by plants for defense against bacterial and fungal invasion. Goldenseal extracts containing berberine are sold commercially as herbal supplements, and can be found at nearly any drugstore and pharmacy in capsule, tea, and other forms. The Food and Drug Administration does not actively regulate the herbal supplement industry, intervening only when products are deemed as unsafe. There is no standard of chemical composition among herbal supplement manufacturers of similar products. This preliminary proof of concepts study developed HPLC methods to quantitate the amount of berberine in various brands of Goldenseal herbal supplement capsules. Three different commercially available brands of Goldenseal extract were tested using quantitative HPLC. Brands tested included Nature's Way®, NOW®, and Pure Mountain Botanicals®, none of which stated the concentration of berberine on their packaging. A standard curve of the HPLC profile of pure berberine was used to determine the concentration of berberine in each of the Goldenseal brands. The berberine concentrations were then compared among the three brands with the use of a one-way ANOVA test. The results of this study demonstrate that there is a statistically significant difference in the concentration of berberine among the three brands tested. NOW® had the greatest concentration of berberine, and Nature's Way® the least. These measured inconsistencies highlight the need of increased consumer awareness when selecting unregulated

herbal supplements. Further application of this method will allow quantification of concentrations of active compounds in other prominent herbal supplements, such as Ginkgo, Echinacea, and St. John's Wort.

166 - Variation in monoterpene emissions across potential hosts and over time as an explanation of local host preference in Phorandendron leucarpum (Raf.) Reveal & M.C. Johnst. (Viscaceae)

Andrew Martinez, Nicholas Reger, Donovan Haines, Christopher Randle

Sam Houston State University, Huntsville, TX

The oak or leafy mistletoe, *Phoradendron leucarpum* (Viscaceae), occurs through much of the southern United States into Mexico and parasitizes a broad range of deciduous trees in its range. However, in any one location *P. leucarpum* is likely to parasitize a small subset of potential host species, even when many are available. In Walker County, Texas, *P. leucarpum*, heavily parasitizes water oak (*Quercus nigra*), but does not readily grow on other trees that serve as hosts elsewhere, such as pecan (*Carya illinoinensis*). Mistletoe seedlings have been shown to orient growth toward pure monoterpenes, volatile chemicals that are typically emitted by plants. We hypothesize that local host preference is driven by the correlation between timing of mistletoe seed availability and monoterpene release associated with carbon mobilization by deciduous trees in spring. Monoterpene gases emitted from pecan and water oak were measured over the period preceding bud break employing a novel GC/MS method incorporating Solid Phase Microextraction (SPME). Results of this experiment were then correlated with tree leaf phenology of potential hosts, timing of fruit availability, and embryo viability in *P. leucarpum*.

167 - RADseq techniques can be applied to DNAs derived from herbarium specimens

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Plant genomic studies are beginning to routinely include DNAs extracted from plant museum (herbarium) specimens. However, many researchers remain reluctant to employ restriction site-associated DNA techniques (RADseq) with these DNAs, since highly-degraded herbarium DNAs could include relatively few intact fragments flanked by appropriate cut sites. Here we apply a basic double-digest restriction-site associated DNA Sequencing (ddRADseq) protocol to multiplexed samples from four genera (*Boechera*, *Draba*, *Ilex*, and *Solidago*). Herbarium-derived DNAs comprised 60% of the sample set, spanning collection dates from 1883-2014. We demonstrate that RADseq is effective in generating large phylogenetically informative datasets from herbarium specimens, and the relationship between specimen age, DNA degradation, and locus recovery is presented. RADseq therefore represents a cost-effective genomics option for labs working with sample sets comprising multiple lineages and tissue types.

168 - Ecosystem functional consequences of predator density as mediated by maternal diversity

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Efforts to conserve and increase biodiversity often emphasize diversity at the species level where each species is assigned a mean functional trait value. However, populations within a species, and individuals within a population, often exhibit considerable intraspecific functional variation. Therefore, instead of focusing on species' mean trait values, intraspecific variation must be incorporated when considering species' ecological role and conservation value. The primary objective of this study was to determine the effects of variation in body size (a functional trait in many aquatic taxa) in an apex predator on ecosystem functioning. We characterized trophic cascades initiated by larval populations of *Ambystoma jeffersonianum* that were varied in the number of maternal lines to create populations of differing size structure. Although previous studies suggest that diversity of maternal lines increases

population size structure, we found no difference in larval size variation between treatments. We analyzed the effects of diversity of maternal lines on larval survival, densities of *Hyla chrysoscelis* tadpoles, benthic macroinvertebrates, zooplankton, phytoplankton, biofilm accumulation, leaf-litter decomposition, and the release of soluble nutrients in cattle tank mesocosms. Results to date indicate salamander survival was significantly higher with increasing diversity of maternal lines. While we are still analyzing the other response variables, the current results necessitate considering the subsequent effects of maternal diversity on predator density for ecosystem function and conservation initiatives.

169 - Home Range and Habitat Use of the Eastern Box Turtle (Terrapene carolina) in the North Georgia Piedmont

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The Eastern Box Turtle (*Terrapene carolina*) is a terrestrial species native to the Eastern United States from New Hampshire to Georgia. *Terrapene carolina* is experiencing range-wide population decline and is classified as vulnerable by the International Union for the Conservation of Nature. Despite the species' status, little research has been conducted regarding home range and habitat use in the Southeastern US. To contribute to the knowledge of the species in this region, we have conducted a radiotelemetry study since 2013 to investigate factors that influence *T. carolina* movement, survival, and habitat use in the Northeastern Piedmont region of Georgia. The study site is composed of mixed hardwood-pine uplands, primarily comprised of oaks and maples; mesic and upland areas dominated by Chinese privet (*Ligustrum sinense*); beaver-created wetlands; and maintained utility line areas. Our research includes 32 radio-transmitted turtles that are tracked on foot by homing 1-2 times a month. From Spring 2013 to October 2018 we collected an average of 57 radiolocations (range: 1 to 179) per turtle. Home ranges (100% minimum convex polygon) for turtles tracked, with a minimum of 30 radiolocations, averaged 1.31 ha (range 0.04-6.94) ha (n=19). Radiotracked turtles primarily used mixed-upland areas and regions dominated by *L. sinense*. Overall, *L. sinense* was the most prevalent understory vegetation at *T. carolina* radiolocations. The assessment of habitat use and home ranges will continue throughout 2019 with tracking and further data analysis.

170 - Relationships between artificial wetland creation on former surface mines and pond-breeding amphibians in the Cumberland Mountains, USA

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Resource extraction activities related to surface mining for coal have eliminated more than 4,000 km of headwater streams and 3000 km^2 of forested habitat across the central Appalachian Mountains. These same activities result in the creation of isolated wetland habitats in areas where topography has been flattened by coal extraction. Since these activities occur in otherwise steeply-sloped areas that are not typically predisposed to wetland formation, surface mining may have significantly altered habitat availability for taxa, such as pond-breeding amphibians, that rely on isolated wetlands to complete their life cycles. We performed a multi-tiered study in Wise County, Virginia – a heavily-mined area of the Appalachian coalfields – to estimate the extent of wetland creation on former surface mines and examine their use by two pond-breeding amphibians, Spotted Salamanders (*Ambystoma maculatum*) and Wood Frogs (*Lithobates sylvaticus*). We used historical aerial imagery and other remotely-sensed datasets to estimate the extent of wetland creation on surface mines within our study area over the past three decades, recording more than 500 new wetlands encompassing more than 300 hectares. We then used field-based surveys to compare habitat between 20 natural wetlands and 20 artificial wetlands located on former surface mines. Artificial wetlands were shallower, located farther from forested habitat, and located at higher elevations than naturally-occurring wetlands across the same area. Use by pond-breeding amphibians was not best explained by coarse classifications of wetland type (e.g., natural or artificial) but by specific wetland attributes, such as depth and distance to forest habitat, that may be influenced by surface mining activities. Our results indicate that surface mining has driven the substantial expansion of isolated wetlands across the Appalachian coalfields, a factor that may be crucial to understanding the status of wetland-associated amphibian taxa across this region.

171 - An eDNA approach to surveying Necturus in Central and Northern Alabama waterways.

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Distribution maps for *Necturus* species have not been updated in Alabama for approximately 43 years. *Necturus alabamensis* has been watched closely due to its protected status, but the other species in the state have not been studied as extensively. By developing a genus specific primer that will detect both *N. beyeri* and *N. maculosus*, the waterways of Central and Northern Alabama can be searched for *Necturus spp.* using environmental DNA techniques. Nineteen water samples were taken from both waterways that have historically held *Necturus spp.,* and new waterways with suitable habitat. The sampling was done during their breeding seasons between November and March in 2017 and 2018. Real-time PCR was used to detect presence or absence of *Necturus spp.* at each site. Results revealed eighteen new sites for *Necturus spp.* and no DNA evidence was found at one of the historical sites from 2012.

172 - The influence of salamanders on leaf litter decomposition in Appalachian headwater streams

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Headwater streams are unique, allochthonous ecosystems in which salamanders are the top predators. They depredate detritivorous macroinvertebrates, including leaf shredders, that occur within the stream bed. If predation affects the abundance of shredders, we expect that this would reduce the rate at which leaves decompose in a stream. Our study was conducted in two headwater streams at Eastern Kentucky University's Lilley Cornett Woods Appalachian Ecological Research Station in eastern Kentucky. Red Maple (*Acer rubrum*) leaves were placed in leaf litter bags, 10 treatment bags containing salamanders and 10 control bags excluding salamanders in each stream. The bags were left in each stream for a total of 10 weeks. The remaining mass was 1.57 . Although treatment bags appeared to decompose faster than control bags, the difference was not significant ($p = 0.08$). However, this trend suggests that leaf litter decomposed more rapidly in the presence of salamanders, which is counter to our prediction. The macroinvertebrate communities between the control (no salamander) and treatment (salamander) leaf bags were compared for family richness, abundance, and relative composition of functional groups (i.e., shredders, predators, etc.). Average total abundance for control bags was higher than treatment bags, although not significantly ($p = 0.09$). We will interpret differences in leaf litter decomposition in the context of macroinvertebrate community composition remaining in each treatment. This study provides a baseline for further investigations into mechanisms affecting leaf litter decomposition, including the possibility that salamanders increase rates of forest litter breakdown.

173 - Texture in Arboreal Lizard Habitat Use

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The adhesive toes of geckos and some other lizards have the remarkable capability to generate strong adhesion and friction on rough and smooth surfaces, allowing these animals to move through their environments unlike many other animals. Pad bearing lizards can be found living in rocky, arboreal, and terrestrial microhabitats in arid, temperate, and topical environments. How the adhesive toe pads of these species may be adapted to their particular microhabitats is an open question. Previous work on anole lizards has correlated toe pad morphology with perch height and urbanization, however, perch texture remains a severly understudied area with predicted mechanical interactions with toe pad performance. Conducting fieldwork in Hawai'i, we investigated habitat partitioning in relation to perch texture. We quantified the texture of perches used by three invasive arboreal diurnal pad bearing lizard species (*Anolis carolinensis, Norops sagrei,* and *Phelsuma laticauda*) to investigate perch texture as an axis of habitat partitioning. We measured commonly used ecomorphological characteristics (perch type, height, diameter, and limb length) focusing on

natural environments as opposed to urbanized habitats. We also developed methods to measure two novel aspects of habitat, perch angle and texture. To measure perch texture, we used a high-resolution impression polymer to collected negative molds of the surfaces we observed lizards using. We than quantified the surface roughness surfaces (Ra) using a stylus contact surface profiler. We found expected habitat partitioning between *A. carolinensis* and *N. sagrei* based on previous work in the Caribbean and Florida. Interestingly, our focal gecko species, *P. laticauda* was using high, wide perches in the canopy, superficially similar to that of *A. carolinensis*, although *P. laticauda* was using this overlapping microhabitat in unique ways, using the undersides of surfaces as well as the tops and sides, yet preferring smooth surfaces.

174 - Molecular phylogenetics and population genomics of map turtles (Genus Graptemys)

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The quantification of biological diversity is an important component of research in the area of conservation biology. The North American Coastal Plain is a recently delineated biodiversity hotspot characterized by high species-level diversity despite comparably low environmental heterogeneity. Aquatic taxa confined to lotic systems in the region typically display high rates of endemism associated with river drainages. Map turtles (genus *Graptemys*) provide a compelling example of the region's biodiversity, comprising the most speciose genus of turtles in the Southeast US. However, efforts to resolve questions regarding species boundaries and phylogenetic relationships among map turtle lineages have been problematic. Here, we present a well-supported phylogenetic analysis for 1,676 loci using 155 individuals from all recognized species and sub-specific groups, across the geographic range of the map turtle clade. Our phylogenetic analyses reinforce existing understanding of the deeper-level patterns of map turtle evolutionary history, but our population genetic analyses reveal new perspectives on several persistent questions regarding more recent patterns of diversity. For example, we find little evidence to support the distinctiveness of the longstanding *G. pseudogeographica* and *G. ouchitensis* species pair, and we find strong support for the recent elevation of *G. pearlensis* from *G. gibbonsi*. These data provide significant insight to the evolutionary history of the genus *Graptemys*, and should inform efforts to preserve diversity and protect populations in this important southeastern US biodiversity hotspot.

175 - Life History of an Imperiled Appalachian Crayfish Species, Cambarus callainus (Big Sandy Crayfish)

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In 2016, a species of crayfish endemic to Central Appalachia, *Cambarus callainus* (Big Sandy Crayfish), was listed by the United States Fish & Wildlife Service (USFWS) as threatened under the Endangered Species Act (ESA) due to limited and declining range caused by various anthropogenic activities, especially those causing stream sedimentation. *Cambarus callainus* was recently described and was formerly considered to represent the Big Sandy River populations of *Cambarus veteranus* (Guyandotte River Crayfish), a species which was listed as endangered under the ESA by USFWS in 2016. A limited picture of the life history of *C. callainus* has been pieced together from surveys conducted over the past decade, as well as from specimens from historic collections. A more complete life history analysis of *C. callainus* is needed, one which follows the same populations a consecutive year, which will better aid state and federal agencies in formulating effective conservation strategies. A twelve-month life history of *C. callainus* began in March 2018, following two populations. One population in the Dry Fork watershed at War, WV; and the other population in the Russell Fork watershed at Haysi & Davenport, VA. The project also examines the community composition and interplay with three syntopic stream crayfish species: *Faxonius cristavarius* (Spiny Stream Crayfish), *Cambarus hatfieldi* (Tug Valley Crayfish), and *Cambarus theepiensis* (Coalfields Crayfish).

176 - Intraspecific variation in the symbiotic protozoan Hyalophysa (Ciliophora, Apostomatida).

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Ciliated protozoans are identified by the pattern of the ciliature on the cell surface. Although small variations may exist, there is usually a consistent pattern that defines a species. Previous studies of symbiotic apostome ciliates in Alabama have revealed that marine species show more intraspecific variation than freshwater species. For this research, grass shrimp infested with encysted ciliates were collected from three marine and three freshwater locations to statistically analyze this variation. At the molting of the host the ciliates unencysted and revealed their characteristic ciliary pattern after they were stained with silver nitrate. The freshwater ciliate, *Hyalophysa bradburyae* (a symbiont of the shrimp *Palaemonetes kadiakensis*) showed little variation. However, *Hyalophysa chattoni*, the protozoan found on the estuarine shrimp *Palaemonetes pugio* in Mobile bay, sorted into two major morphologies in the three populations. Chi-square tests found no significant difference between ciliates at two sites that were geographically close. A third site, located far away from the other two, had ciliates that were significantly different. Additional experiments revealed that the morphology ratios may be influenced by salinity.

177 - Wetting dichotomy in the feeding mechanism of Diptera and the convergent evolution of fluid feeding insects

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Lepidoptera (butterflies and moths) and Diptera (true flies) account for over 300,000 species of fluid-feeding insects and feed from similar sources, therefore both are faced with the selective pressure of needing to remove and feed from tiny amounts of fluids. The two groups also have mouthparts (proboscis) modified with small hydrophilic canals in the distal region, a food canal, and a sucking pump in the head. Studies of Lepidoptera have revealed a wetting dichotomy in their proboscis, where there is a distal hydrophilic region to facilitate fluid uptake and a proximal hydrophobic region, which aids in self-cleaning. Given that Lepidoptera and Diptera are faced with the same selective pressures for feeding, we set out to determine if Diptera have similar wetting dichotomy to that of Lepidoptera. The proboscises of four species of flies were measured for their wetting properties and surface topography using contact angle measurements of water droplets, a capillary-rise technique, scanning electron microscopy, and x-ray phase contrast imaging. Based on contact angle measurements, it was found that the distal parts of the proboscises are hydrophilic and significantly different from measurements on the proximal region, which were hydrophobic. Diptera also were found to employ capillarity and other feeding mechanisms similarly to Lepidoptera, which provides new examples of convergent evolution and indicates an optimal structural configuration and chemistry for efficient fluid feeding.

178 - Polyparasitism in the blood of the Tufted Titmouse (Baeolophus bicolor) and Northern Cardinal (Cardinalis cardinalis)

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Blood parasites are ubiquitous in wild populations of birds and are genetically diverse. The parasites that cause avian malaria and similar diseases are transmitted to birds through the bite of specific insects (Order Diptera). In the wild, blood parasites can be maintained in bird populations as benign infections, while some cases are fatal. We report a high prevalence of polyparasitism (i.e., the presence of more than one parasite in a single host) in the Tufted Titmouse (*Baeolophus bicolor*) and Northern Cardinal (*Cardinalis cardinalis*). Total parasite prevalence was 86.0% in titmice and 74.0% in cardinals as determined using polymerase chain reaction (PCR). Parasite genera *Plasmodium*, *Parahaemoproteus*, *Leucocytozoon*, and *Trypanosoma* were found at significantly different levels in the two bird hosts in either singular or mixed infections. Cardinals were infected significantly more often with *Parahaemoproteus* single infections and *Parahaemoproteus*/*Plasmodium* mixed infections. Titmice, on the other hand, harbored more *Trypanosoma* single infections and *Trypanosoma*/ *Plasmodium* mixed infections. Overlapping habitat between certain insect vectors and bird hosts is a

possible explanation for why specific bird species are infected with specific parasites, but this theory requires further investigation. We also show evidence that infection with certain parasites is influenced by season, host sex, age, and health. Sanger sequencing and phylogenetic analysis of parasite cytochrome *b* and 18S rRNA genes revealed that titmice and cardinals are infected with some of the same genetic lineages of parasites including several novel lineages.

179 - A new mode of insect respiration: Enhanced oxygen delivery to the lepidopteran proboscis

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The ability for oxygen to be effectively delivered to muscles is a major constraint on insect body size, and is the leading hypothesis as to why insects were able to reach extraordinary sizes during the Carboniferous, when atmospheric oxygen concentrations were higher than today. Unlike the elongated structures of some insects, such as the horns on beetles, the elongated proboscises of butterflies and moths (Lepidoptera) are unique in that they contain nerves, muscles, and tracheae, and are capable of complex movements. The respiratory system is remarkably conserved among distantly related insect taxa and consists of a series of conduits that run through the body and open to the surface via holes, called spiracles, in the abdomen. Given this conserved system, the respiratory architecture would require transporting oxygen from the abdomen to the proboscis tip, which can achieve distances exceeding 28 cm; therefore, we investigated other means of oxygen delivery to the proboscis tracheae and its muscles. Using scanning electron microscopy and x-ray phase contrast imaging, we revealed that the proboscis is porous, with nano-sized conduits that extend from the proboscis tracheae to the surface. This discovery provides insight into the physical mechanism of oxygen delivery that might have been necessary for proboscis elongation.

180 - Capillarity in c-shaped conduits: Fluid rise in split proboscises of Lepidoptera without action of the sucking pump

Daytona Hedrick[1], Matthew Lehnert[1], Jianing Wu[2], Ashley Lash[3]

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Capillarity in c-shaped conduits: Fluid rise in split proboscises of Lepidoptera without action of the sucking pumpDaytona D. Hedrick, J. Wu, Ashley L.L. Lash, and Matthew S. LehnertMore than 90% of the approximately 160,000 species of butterflies and moths (Lepidoptera) use a tube-like proboscis to feed on an array of fluids. The proboscis is composed of two elongated c-shaped maxillary galeae that come together to create a food canal. When feeding, capillary action brings fluids into the food canal through small spaces and the sucking pump in the head then generates the negative pressure differential for fluid rise. Due to the microsize of the sucking pump and the small pressure differential created, we hypothesized that fluid rise might be facilitated by the structural architecture of the proboscis, i.e., liquid transport would not rely solely on the sucking pump. In order to visualize fluid rise in the proboscis and decouple the role of capillarity and the sucking pump in the feeding process, we split the proboscises of live and dead butterflies and observed fluid rise in a single, c-shaped galea. We compared the height of fluid rise to a model of predicted height, which is based on a c-shaped conduit and other dimensional parameters. Our results indicated that fluid rise can occur in the food canal of the proboscis without action of the sucking pump. In addition, butterflies with split proboscises retain the ability to feed. The research opens new avenues in studies of microfluidics in c-shaped conduits and provides new insight into proboscis functionality.

181 - Effect of Climate and Individual Characteristics on Seed Production and Morphology of Red Maple (Acer rubrum) in the Central Appalachian Region.

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Under future climate change, plant species are expected to shift their ranges in response to increasing temperatures and altered precipitation patterns. As seeds represent the single opportunity for plants to move, predicting potential range shifts requires an understanding about the relationship

between the environment and reproductive capacity (i.e., how many of the seeds produced have the potential to germinate?). While previous studies focused only on seed production, we analyzed how seed quality as well as seed production was affected by environmental variables and individual-level characteristics. To get variation in the environment, the reproductive output of red maple (*Acer rubrum*) was measured along an elevation gradient in the Monongahela National Forest, WV. In spring of 2018, 44 seeding trees were identified, and another 44 non-seeding trees were randomly selected for comparison. For each tree, canopy volume, tree age, diameter at breast height, stand density, age and basal area increment were measured. Two seed traps were placed under seed-bearing trees to collect samaras and quantify total seed production. From each tree a random subsample of the collected seeds was micro-CT scanned to determine embryo fill and seed cavity volume, photographed for morphology measurements, and then used for germination trials. Older trees were the most likely to produce seed. Seed production was highest in individuals with a smaller DBH who experienced fewer frost days during flower and were in stands with a high hemlock basal area. Trees were more likely to have embryo development if they were in a stand with high hemlock basal area and smaller, and the same factors plus height increased the average size of the embryos. Germination success was influenced solely by seed size. In summary, older trees in protected microclimates, with a small DBH, in hemlock dense areas are most likely to produce the most potentially viable seed.

182 - Integration of genetic structure and demographic data in the endangered Pyne's ground plum (*Astragalus bibullatus*; Fabaceae)

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Conservation efforts to aid the recovery of rare plant species can be challenging in the context of small, isolated populations scattered across a fragmented landscape. These "islands" of rarity may be subjected to the pressures of genetic drift and inbreeding depression. *Astragalus bibullatus* (Pyne's ground plum) is a federally endangered legume endemic to the limestone cedar glades of Stones River Basin, Tennessee. Temporal changes in genetic structure were previously inferred from allozyme analysis of the soil seed bank, indicating increased selfing and decreased outcrossing over time. Additionally, AFLPs identified previously undetected sub-structuring among sites. Here we present the first attempt to integrate genetic analyses with long-term demographic data to provide additional insight for recovery efforts in this species. We genotyped 302, permanently tagged individuals from eight sites (five natural, three reintroduced) using seven, polymorphic, nuclear microsatellite loci. We genotyped an additional 59 individuals from a ninth (natural) site that was not included in the demographic study. Using GenalEx, we calculated standard population genetic summary statistics, pairwise population F_{ST} values, and performed principle coordinates analysis. Individuals and populations were assigned to genetic clusters using a Bayesian approach as implemented in STRUCTURE through the CLUMPAK pipeline. We used Wang's estimator as implemented in the *r* package *related* to assess relatedness within and among populations. We generated a bootstrapped UPGMA dendrogram based on Nei's genetic distance using the 'aboot' function in the *r* package *poppr*. Finally, we used logistic regression to determine the probability of fruit production as a function of unbiased heterozygosity across sites. Analyses indicated some limited structure among sites that corresponds with geographic distance. Mean relatedness within sites indicates relationships varying from half-sibs to unrelated. There was a significant positive relationship between probability of producing fruit and unbiased heterozygosity. Implications for continuing recovery efforts will be discussed.

183 - Copperhead Foraging Ecology at a Recreational Site in the Daniel Boone National Forest

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One of the most pervasive threats to wildlife species are their interactions with humans. Recreational areas provide opportunities to engage the public and promote wildlife conservation, but can also lead to negative interactions with species sharing these habitats. Copperheads (*Agkistrodon contortrix*) are known to use open areas created by recreational sites, trails, and roads. Their wide geographic distribution and camouflage patterning often result in accidental encounters with humans.

Consequently, copperhead bites represent the second most reported source of envenomation in the United States. While copperheads are observed in recreational areas, little is known about their behavior and the relative effect of habitat composition at these sites. The goal of our study was to understand the behavior, temporal usage, and movement of copperheads within recreational areas to inform management decisions directed at reducing human-copperhead interactions. Visual encounter surveys were conducted nightly during the active season (May-August). We used focal sampling to record the total amount of time individuals spent moving, searching, climbing, eating, engaging in combat and reproduction, the distance traveled between habitat patches, and the directional angle change between habitat patches within the study site. Snakes were observed actively searching for and eating cicadas and other small invertebrates both on the ground and in small trees. Mobile searching consisted mostly of moving between habitat patches and searching in vegetation within patches. Non-mobile searching was observed an equal amount of time as mobile searching and consisted mostly of 'periscoping' behavior in the direction of different patches within the site. Further analysis will investigate the difference between male and female behavior, as well as potential spatio-temporal patterns related to temperature and micro-habitat.

184 - Phytochemicals and genotype choice by insects in an old field plant species: a growing consensus and future questions addressing cytotype effects

Ray Williams

Appalachian State University, Boone, NC

Intraspecific genetic variation in widespread and numerically dominant plant species have the potential to strongly influence associated insect diversity and abundance. Both structural and phytochemical variation among genotypes may contribute, though arguably nutritional and defense chemicals in plants may play a primary role due to their demonstrated effects on insect feeding and fecundity. A number of investigations in my laboratory have shown the importance of leaf terpenes in determining insect choice and abundance in genotypes of the old-field plant species *Solidago altissima*. Using a common garden design with multiple genotypes planted in a natural habitat, we have found that both a numerically dominant aphid and dominant chewing herbivores differ among genotypes, as do leaf terpenes, which are related to insect abundance. An additional level of variation affecting insects may exist in *S. altissima* since the species has at least three known cytotypes (2n, 4n and 6n). To examine if chromosome number results in phytochemical variation among not only genotypes but also cytotypes, plant rhizomes and leaves were collected along a geographical range of ploidy from western Illinois (predominantly 6n) to eastern Nebraska (predominately 2n). Leaves were analyzed for terpenes and plants propagated and placed under natural conditions in a common garden to quantify insect abundance among cytotypes. For midwestern US collected leaves, our laboratory found significant ($P < 0.05$) differences among cytotypes for some terpenes and differences among sites (possible genotype effect). In the common garden similar results for terpenes was seen, with a non-significant, yet a strong trend, for aphid species abundance to increase as plant chromosome number did. These data led to the development of additional studies to more rigorously explore the effect of *S. altissima* cytotypes on associated insects.

185 - Demographic and spatial analysis of Blackwater Ecologic Preserve (Isle of Wight, Co., VA) provides insight into the origin of longleaf pine (Pinus palustris) stands

Peter Schafran[1,2], Nicholas Flanders[2], Toni Dotterer[2], Isaiah Amos[2], Lytton Musselman[2]

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The Blackwater Ecologic Preserve (BEP) contains the best preserved remnant longleaf pine communities in Virginia, but the provenance of the trees is uncertain. Oral history records that some of the longleaf pines might have been imported to Virginia by the previous landowner. To test whether spatial or morphological data could provide evidence that some trees were planted while others regenerated naturally, we located and measured height and diameter for all longleaf pines at the BEP. While height and density differed significantly between putatively planted and natural stands, multiple linear regression analysis of height, DBH, and stands indicate other underlying factors may be driving differences in growth. Our results agree with the oral tradition that the southern portion of the BEP was replanted and the northern portion regenerated naturally. However, our data cannot isolate planting as the only variable explaining the current distribution of longleaf pine at the BEP.

186 - Bombus sylvicola and Bombus balteatus genetic differentitation across the Central Rocky Mountains.

Isabel Sullivan

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The Intermountain Western US has experienced significant environmental impacts from climate change over the last 50 years, creating novel challenges for species that occupy these areas. Metapopulation theory predicts that extant populations with greater interconnection via dispersal and gene flow should be more likely to withstand such environmental challenges exhibiting greater persistence. These projects aim to investigate the relative extent of genetic connectance among populations of Bombus balteatus and B. sylvicola, two ecologically important native bumblebee species in alpine habitats of the Central Rocky Mountains, Colorado. The species historically comprised > 95% of samples captured in the region during the 1960s and 70s but have experienced declines in their relative abundances in recent years; this has likely been facilitated by climate-mediated declines in available floral food resources coupled with increased competition from upwardly mobile lowland Bombus species. We first examine population genetic structure using microsatellite markers and use geospatial modeling to determine how various landscape features (i.e. elevation, precipitation, land-use, etc.) influence dispersal and gene flow by correlating genetic distances to landscape resistance distances, which are computed using the connectivity modeling program Circuitscape. B. balteatus and B. sylvicola are both restricted to high elevations (> 3,500 meters), yet differ in tongue length and body size, which may influence their dispersal ranges. Comparisons of these two species sampled from identical elevations and study sites may elucidate differences in how they are able to disperse across the landscape and exchange genes. Comparing how the population genetic structure of these two alpine bumblebees is influenced by various landscape features should allow for prediction of the relative probability of persistence. Populations at high elevations typically experience relatively strong genetic drift and population structuring, so conservation management strategies should be directed to the populations that are most at risk of low genetic diversity and isolation.

187 - Is there sexual dimorphism in Spicebush (Lindera benzoin) prior to fruit production?

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Spicebush (*Lindera benzoin)* is dioecious, spawning the potential for sexual dimorphism and biased sex ratios. Studies of established populations have shown that females often grow slower than males and populations commonly show significantly biased sex ratios. Dimorphism may result from differential costs of reproduction, in that females invest more resources to flowering and fruiting than do males to flowering alone. Dimorphism may alter growth, mortality, and flowering frequency in ways that ultimately affect observed sex ratios. If differential costs of reproduction are the proximate cause of dimorphism, differences should not arise until significant fruit production commences. To test this, we have grown >500 plants from seeds collected in 2013 from 15 plants at a Maryland field site that has shown significant female-bias for ~25 years. Annually, we measured the basal diameters and heights of all dormant stems. Flowering began in 2016 and sex determinations have been made annually thereafter. As of 2019, we have identified 259 female, 217 male, and 72 non-reproductive individuals. Although the overall sex ratio was only marginally biased, nine of 15 maternal plants produced female-biased offspring sex ratios (three significantly so) and six produced male-biased ratios (three significantly so). Variation in offspring sex ratio might result from pollen competition (certation) favoring femaleness when local male densities are high. Although the growth period assessed (2014-18) preceded the bearing of substantial reproductive costs, females had larger basal area and volume of the largest stem, larger genet volume (sum of stem volumes), and lower stem number than males. While relative growth in stem height, volume, and number, and genet volume did not differ significantly between the sexes, females showed higher growth in basal area of the largest stem. Because females produced fewer, faster growing stems than males, sexual dimorphism was apparent prior to the onset of significant reproductive costs.

188 - Intraspecific Morphological Variation in *Chamaecrista fasciculata* from the Deep South is maintained in a Common Garden

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Studies of the underlying basis for intraspecific variation are a major focus of evolutionary ecology because they provide insight about the adaptive nature of such variation and shape our interpretation of taxonomic boundaries. *Chamaecrista fasciculata* (Fabaceae) exhibits a broad geographic distribution and intraspecific morphological variation in eastern North America. Regional morphological and ecological variants are commonly recognized in this species and have been treated at different taxonomic ranks. Populations in the Southeast are particularly diverse, possibly reflecting historical evolutionary divergence, but previous studies have not shown genetic divergence in DNA sequence markers that corresponds to morphological variants. To gain a better understanding of morphological variation of *C. fasciculata*, we grew seeds collected from five populations across Mississippi in a common environment and quantified variation in leaf and stem traits. Growth forms included short plants with many branched stems, as well as relatively unbranched tall stems. Mean number of leaves per plant also varied, being greatest on plants with a highly branched architecture. Significant latitudinal differences were observed in the number of leaves and stems, but the populations did not differ significantly in final weight. Differences were detected in stem and leaf pubescence. Whereas most plants exhibited some stem pubescence, leaflet pubescence varied more extensively and significantly across populations. Leaflet pubescence may reflect adaptation to temperature gradients or herbivore intensity across Mississippi. Finally, plants from higher latitudes flowered earlier than coastal populations, but few significant differences were detected in overall number of flowers produced. This study demonstrates that phenotypic variation commonly found in *C. fasciculata* is maintained in a common environment. These results will aid in understanding how *C. fasciculata* adapts to local environmental effects and provides a framework for interpreting how these traits could influence variable outcomes as the plant interacts with other species in communities across the Southeast.

189 - Investigating Populations of Brook Trout (Salvelinus fontinalis) Above and Below Waterfalls in Virginia

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Anthropogenically driven factors, such as increasing temperature and sediment in valley streams, acidification of mountain streams, and the introduction of non-native trout, are restricting habitat suitable for healthy populations of eastern brook trout (*Salvelinus fontinalis*) throughout their native Appalachian range. Brook trout are important top predators in mountain streams and are a favorite of anglers. It is crucial that remaining populations in ideal habitats be identified and preserved. Waterfalls are geologic knickpoints preventing base-level lowering that create unique landscapes above them, which may alleviate the temperature-productivity/acidity "habitat squeeze" for populations of brook trout and could serve as potentially ideal targets for conservation efforts despite being isolated. This study compares brook trout populations above waterfalls to those below them in Virginia mountain streams. One-hundred meter reaches above and below seven waterfalls in Virginia's George Washington and Jefferson National Forest were sampled for brook trout via 3-pass, block-netted, backpack electroshock depletions. All trout were counted, weighed, and measured for fork length. The response variables are differences brook trout above and below waterfalls in 1) percent dominance, 2) biomass, 3) population size and 4) length-weight index (Fulton's Condition Factor). Brook trout percent dominance (100 vs. 26.03) is greater above than below waterfalls, but not significantly so. We found overall biomass (885.3 vs 284.6 grams per 100m) and abundance (26 vs.12 individuals per 100m) of brook trout populations above waterfalls to be greater than their below waterfall counterparts. We also found brook trout above waterfalls to have a greater condition factor (1.086g/cm3 vs 1.0636g/cm3) than those below waterfalls (α=0.1). Lastly, we found populations above waterfalls where their occurrence was previously unknown. Despite being isolated, brook trout populations above waterfalls were just as if not more robust than those below and may be good targets for conservation.

190 - Conservation and Distribution of Creaserinus fodiens (Digger Crayfish) in Pennsylvania

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Because crayfishes are the 4th most imperiled group of aquatic or terrestrial organisms in North America, agency efforts to assess the status of the fauna have increased in recent decades. Historically these assessments have focused on stream-dwelling species while primary burrowing crayfishes have been overlooked. Pennsylvania has initiated numerous surveys to determine modern distributions and conservation status of its crayfish fauna and in 2014 began a primary burrowing crayfish survey. These efforts led to the first documented record of *Creaserinus fodiens* (the Digger Crayfish) in the state. In 2017 a dedicated effort to determine the distribution and conservation status of *C. fodiens* commenced in Erie and Crawford counties. Initially, visual surveys were conducted for suitable habitat (roadside ditch, ephemeral pool, wetland, etc.) and/or burrows with chimneys, with the goal of collecting presence/absence data. Sites with suitable habitat, burrows, or chimneys were subsequently sampled for crayfishes. If water depth was <0.25 m collections were made via dipnet and if water depth was ≥0.25 m the site was trapped for 3 months. Each site was analyzed for percentage of land use type using the National Land Cover Database with a 200 m diameter buffer. These data were modeled using logistic regression to elucidate habitat preferences of *C. fodiens*. NatureServe's ranking system was used to designate conservation status in the state of Pennsylvania. Two populations of *C. fodiens* have been discovered to date with additional sampling to take place in 2019.

191 - Effects of sub-lethal levels of antibiotics on the growth of freshwater algae.

Asia Gladney, Matthew Heard

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Urban rivers have seen an increase in the introduction of antibiotics to their waters over time. While this is of growing concern because of the potential to impact freshwater species, there has been limited research done to date to examine the impacts of these pharmaceutical introductions. In this study, we examined how three common pharmaceuticals: penicillin, erythromycin, and tetracycline influenced the growth and survival of two common groups of freshwater algae: *Chlorella spp.* and *Euglena spp.* In our study, we found that antibiotics significantly affected the growth and survival of both types of algae. However, we found no consistent trends between antibiotics and for our two algae species. Collectively, our findings indicate that antibiotics have the potential to impact the growth and survival of freshwater biodiversity in urban rivers. However, they also suggest that more work is needed to fully understand this issue.

192 - Urban Stream Restoration: Conveyance and Material Processing Channels

Madeline Berg

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Stream restoration is gaining popularity in the Mid - Atlantic region to offset impacts from urbanization, such as increased levels of impervious surfaces and decreased vegetation along stream banks, changing water flow patterns. Due to these changes, urban stream ecosystems are flashy and result in high erosion rates increasing the amount of sediments and nutrients entering the Chesapeake Bay. Different stream restoration practices can play a large role in the amount of nutrients and organic matter leaving a stream system and the amount of habitat that is present within the stream channel. Due to the recent interest in stream restoration to help the health of the Chesapeake Bay, this study was undertaken to evaluate two restoration practices: conveyance channels and material processing channels. Ten streams, five of each practice, were evaluated in terms of macroinvertebrate diversity, abundance, and richness and percent cover of organic retention. The upper and lower reach of each stream was sampled by two methods for macroinvertebrates and was sampled by transects to measure organic retention. Results from this study suggest that the stream restoration practice used when restoring urban streams can impact the amount of organic retention that occurs within the stream channel as well as impact the ability for the stream channel to provide the best habitat for in-stream biota. To further evaluate this question, this

study should be continued over multiple years through different seasons to see if the trends persist or continue to get stronger as the site ages.

193 - Ecosystem functional consequences of top predator amphibian mortality due to the invasive shrub, *Lonicera maackii*

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Lonicera maackii (Amur Honeysuckle) is an invasive woody plant species that is present across the United States. Previous studies have assessed the biotic effects of honeysuckle, as well as abiotic effects such as changes in soil chemistry, altering ground level light, and forest floor temperature. Although directs effects of *L. maackii* on native terrestrial plant communities are well studied, little is known about its indirect effects, especially in aquatic ecosystems. Based on limited prior studies, we predicted addition of *L. maackii* leaves to aquatic systems would increase mortality of a top amphibian predator due to the release of phenolic compounds that inhibit respiration. We developed mesocosm experiments to characterize the cascading effects of increased top predator (*Ambystoma maculatum*) mortality on larval growth, invertebrate densities, zooplankton densities, leaf litter decomposition, primary production, and soluble nutrients. Although this research is ongoing, survival was lower in tanks with *L. maackii* (1%) than in tanks with native leaf litter alone (38%). Mesocosms with *L. maackii* leaves also contained substantially more mosquito larvae, suggesting reduced water quality. Continued data collection and analyses will determine if increased apex predator mortality in *L. maackii* mesocosms alters aquatic ecosystem functions. Since *L. maackii* increases mosquito colonization, oviposition, and/or larval survival, it may be considered that *L. maackii* has serious potential human health concerns.

194 - Short term effects of polystyrene on Aiptasia pallida

Natasha Sawickij

Florida Southern College, Lakeland, FL

This study focuses on the effects of polystyrene plastic (PS) on the anemone *Aiptasia pallida*. PS plastic is commonly used worldwide and is found in a wide variety of products. Some of these include plastic used in food services, packaging for shipping, as well as for many medical uses such as tissue culture trays. Due to the increasing amount of plastic produced, much of it is ending up in our oceans. It is estimated that there is at least 12.7 million metric tons of plastics being released into our oceans each year. This study looks at the short term effects plastic consumption has on *Aiptasia pallida*, specifically overall short term health effects. Examples of effects are weight and tentacle area, retention time of plastic throughout a twelve day study, and the anemones' ability to extract heavy metals out of the plastic. A total of ten anemones were exposed to plastic for twelve days, ten kept at 20°C and ten kept at 25°C. It was found that there was no statistical difference between retention time of plastics or the different temperature treatments (P-value 0.2048). It was found that during the experiment, the overall anemone weight decreased, resulting in a statistical difference between day one and day twelve of both treatments (P-value 0.001 and 0.005 respectively). It was also found that throughout the experiment the average tentacle area decreased for both treatment types, however 20°C was not statistically significant with a P-value of 0.09 while 25°C was statistically significant with a P-value of 0.0001. Overall it was found that anemones kept at different temperatures did not show any preference for consuming plastics, while overall health decreased in both cases due to plastic exposure

195 - Investigating the Physiological Effects of Varying Salinities on Adult Grass Shrimp, *Palaemonetes pugio*

Kaytlin Pepper

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Louisiana's coast line is diminishing by over 16 square miles each year. With this substantial land loss, the state is implementing a number of recovery projects aimed at preserving or building new land. One of these activities is the creation of diversions, manmade branches off of the main Mississippi river waterway, that will facilitate sediment deposition in the upper estuaries. However, diversions have the potential to lower the salinity of these aquatic habitats, which could negatively

affect the resident organisms. One of these key species is the daggerblade grass shrimp (*Palaemonetes pugio*). While grass shrimp can tolerate salinities from 1-55 ppt, their optimum salinity range is 4-16 ppt. It is not known how an environmental shift to lower salinities in coastal Louisiana will affect grass shrimp and, in turn, ecosystem stability. In this study we determine the lower salinity tolerance of grass shrimp by measuring mortality, feeding response, respiration rate, and osmotic pressure after exposure to low salinity (0, 3, 6, 9) for seven days. Individuals at 0 ppt exhibited a decrease in survival of 40 to 60% by the end of the treatment period and a significantly slower feeding response times. Further, respiration rates in the 0 ppt group were lower than the 3, 6, and 9 ppt groups and osmotic pressure was lower in all groups below 9 ppt. This indicates that although previous studies have found daggerblade grass shrimp in lower salinities, these levels may not be optimal for physiological function, especially as salinities reach 0 ppt. Our findings suggest that if diversions were to be implemented along the Mississippi River and the water salinity significantly lowered, grass shrimp populations could experience severe negative effects such as mortality and poor physiological functionality.

196 - Biogeographic analysis of bacteria in the Sargasso Sea using high-throughput sequencing methods

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Marine microbes provide the backbone for pelagic ecosystems by cycling and fixing nutrients and establishing the base of food webs. Despite their importance, the prevailing theory regarding their dispersal and biogeography was posited over 70 years ago and asserts that marine microbes are globally distributed with no significant barriers to large-scale dispersal such that environmental parameters alone select for dominant communities. Our study utilized high-throughput Illumina 16S amplicon sequencing on whole-community bacterial samples. DNA was extracted from water collected from the surface (n=18) and at depth just below the chlorophyll-*a* maximum (mean depth=115.4 m; n=22) in the Sargasso Sea and adjacent areas. A total of 711 unique operational taxonomic units (OTUs) were identified at the 97% similarity threshold, with an average of 242 (± 48 SD) OTUs per sample, identifiable to the genus level in most cases. Latitude, temperature, salinity, chlorophyll-*a* fluorescence, nitrate concentrations, and localized *Sargassum* density were not significantly correlated with alpha diversity (Shannon, Chao1, Heip's E) for all samples and within each subset categorized by depth. Discrete community assemblages were observed within the oceanographic regions studied. The relative importance of environmental versus spatial factors in structuring these emergent groupings was assessed using UniFrac distance and Mantel testing. This study advances understanding of microbial biogeography in the pelagic oceans and highlights the use of high-throughput sequencing methods in studying microbial community structure.

197 - Smooth-tipped proboscises of Lepidoptera are adapted for feeding from floral tubes

Rena Fonseca

Kent State University, Canton, OH

Butterflies and moths (Lepidoptera) use their proboscis to feed on a variety of fluids, including rotting fruit, sap, and nectar. Proboscis morphology relates to feeding habits, and non-flower visitors have a brush-like tip due to the enlarged sensilla styloconica, which enhances the capillary pull of viscous fluids from surfaces. Lepidoptera with a smooth proboscis tip are assumed to be adapted for feeding from narrow floral tubes; however, this has not been experimentally demonstrated. Here, we provide experimental evidence from feeding trials that smooth proboscises are more efficient at feeding from floral tubes. In addition, we relate this relationship to proboscis morphology and the wetting properties of the proboscis cuticle.

ASB Oral Presentation Lightning Talks

197 - Stop Teaching Mendel in Intro Genetics

Jennell Talley

Georgia Gwinnett College, Lawrenceville, GA

Mendelian genetics is excellent for teaching basic concepts of inheritance to novice students due to Mendel's elegant and simple experiments with *Pisum sativum*. Our understanding of genetics today is more complex than what Mendel's experiments imply; additionally it is becoming clearer that some of the misconceptions or alternative frameworks that students have regarding inheritance might be due to the way we teach Mendelian inheritance patterns. Three of the most common misconceptions students hold are: (1) genes are the only factor that determine phenotype (deterministic genes), (2) that genes only have two alleles and that these two alleles are always either dominant or recessive; (3) additionally students often believe that a dominant allele is the most prevalent in the population even after examples of very rare phenotypes due to dominant mutations are discussed. I am suggesting that we reflect on how we teach genetics in introduction to genetics courses and consider transitioning away from teaching Mendel's experiments as proofs of his laws and instead use meiosis to reinforce Mendel's laws. Then teaching genetics showing students the complexity we know exists and that they will encounter in the 'real world.' For example, when teaching meiosis no longer using 'big B' and 'little b', but instead B_n where *n* is a number denoting allele number. Using numbers higher than two shows students that there can be many alleles of a particular gene. This can be used as a stepping stone to discuss interactions of multiple alleles, the relative nature of dominance, and the influence of mutations on genes; it also begins to introduce the concept of haplotypes, which is important in many disciplines. Students need to begin to let go and rebuild their understanding of the complexity of genetics early in the course. The emphasis placed on Mendel stifles this transition.

198 - I am your father…or am I? Parentage analysis in amphipod Crustaceans.

Kristine N. White, Sarah Cuccinello

University of Tampa, Tampa, FL

Marine amphipod crustaceans in the family Leucothoidae have developed extended parental care and can be divided into two subfamily-level biological groups (leucothoids and anamixids). Males and females of the leucothoid group look very similar to each other, while some males of the anamixid group look quite different from the females. Prior to the observation of a radical transformational molt, the dissimilar males were classified in a separate family than the females and similar males of the same species. Members of this group share characteristics typical of eusocial organisms such as ants and bees, living in colonies with overlapping generations. However, the defining characteristic of eusociality, having reproduction restricted to a few individuals, has yet to be documented with direct evidence. Captive observations are difficult due to the small size and complex ecology of the amphipods; therefore, determining which males are producing offspring will more easily accomplished using molecular data. The current project involves developing molecular microsatellites for one species of amphipod from Florida to determine which males are reproducing. The ultimate goal of the project is to further the molecular dataset for leucothoid amphipod crustaceans and to clarify whether these amphipods are truly eusocial or are simply utilizing a cooperative breeding strategy.

199 - Photogrammetric Determination of Canopy Convergence in a Bottomland Hardwood Forest

Melissa Bloch[1], Joydeep Bhattacharjee[2]

[1]University of Louisiana at Monroe, LA, [2]University of Louisiana, Monroe, Monroe, LA

Competition for light among species can lead to morphological alterations in canopy structure. In dense herbaceous stands, many plants will avoid being shaded by adjusting their height to maintain a similar height with neighbors. While old-growth forests usually have high variability in vertical structure, planted stands often display height convergence and typically require intensive management to increase the structural and functional diversity. Unlike the known shade-avoidance responses that modulate height in dense herbaceous stands, the drivers of height convergence for forest canopies are not yet well studied. A visual analysis from atop a 37 m tower in the middle of one

of the largest remaining tracts of bottomland hardwood forest led us to hypothesize that there is a systematic convergence of the tree heights. In this preliminary study, to determine height convergence, we developed a time-efficient, photogrammetric approach to acquire the heights of individual trees in the planted bottomland hardwood forest. Using an unmanned aerial vehicle equipped with a high-resolution camera, a series of uniform flights were conducted. The aerial images collected were mosaicked, and a digital elevation model and digital surface model were produced. The difference between the surface and elevation models generated the canopy height model. The canopy height model was used to delineate the crown boundaries, and the highest point of each crown was extracted as the individual tree heights. The estimated tree heights from this method were validated by field measurements, with a root mean square error of .57 m. We also found a significant degree of height symmetry in the plots analyzed thus far, with most variability occurring near gaps. We plan to further use this photogrammetric method, along with LIDAR data, to determine convergence on a larger scale and better understand its drivers.

200 - Hydrophobicity and self-cleaning properties of the brille of snakes

Susanna Walker, Matthew Lehnert

Kent State University at Stark, North Canton, OH

The brille is the transparent scale that covers the eyes of snakes. Snakes lack eyelids, therefore, the brille is responsible for protecting the eye from damage. Due to the lack of eyelids and limbs, snakes are unable to mechanically clean dirt and debris from the brille, thus requiring other means for keeping their eyes clean. The purpose of this study was determine if the brille is superhydrophic, which would provide self-cleaning properties. In order to assess the wetting properties, water droplets were placed on the brille of corn snakes (*Pantherophis guttatus*) and their contact angles were measured. The surface was further examined for nano-structures that would support hydrophobicity using scanning electron microscopy. The results indicate that the brille is hydrophobic, which is likely due to a hydrophobic chemistry that is further enhanced by nanoscale surface roughness, and would provide means for removing debris that could cover the eye.

201 - Advances in Big Data and Digital Imagery Are Helping to Push Environmental Science Forward

Matthew Heard

Belmont University, Nashville, TN

Technological advances in instrumentation, data storage, and digital imagery are creating massive amounts of data that could be used to answer some of the most pressing environmental questions. In this lightning talk, I'll examine some of the creative new approaches that researchers are taking to utilize this novel data. In addition, I'll examine how collaborations with data analytics experts, computer scientists, and artists will help us to open up new avenues of research in biology and environmental science.

202 - Horizontal Gene Transfer as a Mechanism for Convergent Evolution in Divergent Species

Jennifer Kovacs[1], Ellen Martinson[2], Caitlin Conn[3], John Werren[4]

[1]Spelman College, Atlanta, GA, [2]University of Georgia, Athens, GA, [3]Emory University, Atlanta, GA, [4]University of Rochester, Rochester, NY

“How do organisms acquire new traits?” is a central question in evolutionary biology. We know that new traits can arise a number ways including mutations, gene duplications, and chromosomal inversions. We also know that prokaryotes, such as bacteria, can acquire traits from other bacteria or from their environment through a process known as horizontal gene transfer (HGT). These horizontally transferred genes can allow their new host to rapidly adapt to their environment. Until recently, it was thought the HGT happened only in prokaryotes, but recently multiple cases of functional HGT have been documented in a wide range of eukaryotes, including a variety of arthropod species. We currently have a very limited understanding of how widespread HGT is in eukaryotes and how it has contributed to the evolution and diversification of eukaryotes. Evidence is mounting that HGTs may be common in eukaryotes, and the functional significance of such HGTs may be an important process by which metazoans acquire novel gene functions. In fact, in several recently

documented cases, it appears that the same genes have been independently transferred to multiple species. I am particularly interested in determining whether these HGTs played a role in the acquisition of convergent phenotypic traits necessary for the invasion of novel niches by divergent arthropod species. The goal of this project is to identify, validate and characterize HGTs in fifteen species of blood-feeding and herbivorous arthropods. We are particularly interested in the role that HGTs play in allowing organisms to exploit new environments, therefore we will pay special attention to HGTs that are shared across multiple species that share a similar ecological niche, but are absent in more closely related arthropods that have a different feeding behavior.

203 - Coefficients of conservatism in Arkansas: Validation, changes in understanding of geographic regions after a floristic survey, and an exploration of ecoregion bias

Diana Soteropoulos

Arkansas State University, Jonesboro, AR

Coefficients of conservatism (CoC) are the basic metric in floristic quality assessment to quantitatively and objectively describe a plant community assemblage in a given area based on species presence, regardless of physiognomy, frequency, dominance, or productivity. Plant community assessment is based on how conservative the species present are, i.e., the degree of fidelity to a specific habitat type or the degree of tolerance to anthropogenic habitat disturbance. CoC typically range from 0-10, where 0 indicates weedy species with no fidelity to natural communities and 10 indicates a species with high habitat specificity never found outside natural communities and sensitive to minor habitat degradation. The degree of habitat specificity and sensitivity to habitat degradation for each species within an area must be considered for a specific geographic area. Currently, six botanists are developing statewide CoC for Arkansas, spanning seven ecoregions across the state. In collaboration, I will test the validity of these statewide CoC using a null model approach, leading to the refinement of over- or under-valued taxa. After CoC validation, I will use CoC to compare species conservatism across Arkansas's ecoregions, which has long-standing botanical bias against the under-studied, under-collected Mississippi Alluvial Plain ecoregion spanning the eastern third of the state. Lastly, I will analyze the impact of a floristic survey on our understanding of the conservative status of an area's flora. Evaluating the impact of a floristic survey, aside from the addition of new county records, can provide information about which areas have the highest number of conservative species as areas of higher conservation concern and validate the importance of the time and effort to conduct a systematic survey, which has been criticized as unnecessary in the 21st century.

204 - Increased alpha diversity, but decreased beta diversity, in avian communities following Eastern Hemlock decline

Andrew Laughlin, Douglas Black, Kristin Anderson

University of North Carolina Asheville, Asheville, NC

Eastern Hemlocks have suffered major declines in the Great Smoky Mountains National Park (GSMNP) since the arrival of the invasive Hemlock Wooly Adelgid (HWA) there in 2002. Despite treatment efforts, large swaths of hemlocks continue to die, threatening hemlock ecosystems in GSMNP and throughout eastern North America. This study seeks to understand the changes in bird community structure due to the decline of this important ecosystem in the GSMNP. We hypothesized that the burgeoning understory that results from the loss of forest canopy will attract some species of birds, whereas Hemlock-dependent species will decline. In the summer of 2018, using standardized point-counts, we re-surveyed the bird communities and vegetation cover of more than 200 sites that researchers from NC State surveyed in the late 1990's, prior to the arrival of HWA. We compared bird species richness and abundance between the two time periods (1990's and 2018) in both formerly Hemlock-dominated sites and in other forest types. Our re-surveys will continue for two to three more breeding seasons, but preliminary results indicate a few key points: a) species richness (α-diversity) may actually be increasing in the formerly Hemlock-dominated stands, but b) the bird communities in these stands are starting to resemble those in nearby forest types. Such biotic homogenization tends to decreases β-diversity, blurring the distinctiveness of the different communities from each other.

205 - Sporophyll Anatomy Differences among Four Isoetes Species

Lauren Zeh Heyd[1], Lytton John Musselman[1], Peter Schafran[2]

[1]Old Dominion University, Norfolk, VA, [2]National Museum of Natural History, Washington, DC

Sporophylls of four species of *Isoetes* were studied with scanning electron microscopy and light microscopy. A relationship between a partially- or fully-aquatic habitat and the presence of peripheral strands was noted in *Isoetes* by Engelmann in 1882. Sporophylls of *Isoetes junciformis*, a rare amphibious species endemic to Georgia, are notably rigid suggesting peripheral strands in the tissue. Cross sections of this species as well as *I. occidentalis, I. melanopoda,* and *I. prototypus* were studied. No strands were found in *I. occidentalis* or *I. prototypus*. Only *I. junciformis* and *I. melanopoda* had peripheral strands. However, the size, location, and number of these strands differed between *I. junciformis* and *I. melanopoda*. The presence or absence of these features may be of taxonomic value in the genus, and could be a mechanism for sporophyll rigidity.

206 - Grasslandia: a journey to a different time and place

Dwayne Estes[1], Theo Witsell[2], Alan Weakley[2,3], Reed Noss[2]

[1]Austin Peay State University, Clarksville, TN, [2]Southeastern Grasslands Initiative, Clarksville, TN, [3]University of North Carolina Herbarium, Chapel Hill, NC

No one disputes the fact that eastern North America has undergone major change since Europeans began arriving 500+ years ago. Many believe vast unbroken forests covered the eastern U.S. prior to 1492. A new vision is emerging in which data reveal the presence of >100 million acres of historical grasslands. More than 90 percent of these have disappeared or have been transformed to an unrecognizable state. With grassland loss has come ecological collapse of pollinators, grassland birds, small mammals, certain reptiles and amphibians, and thousands of plant species. Few understand or would believe how extensive these grasslands were historically. A major reason for this is that most were gone before the camera was invented, before they could be painted or sketched, and before trained naturalists could describe them. Our lack of ability to visualize these landscapes and the dearth of high-quality reference sites makes it difficult to effectively conserve and restore these imperiled habitats. Landscape, vegetation, and climate models coupled with artist reconstructions can help us re-imagine the southeastern U.S. Imagine being able to “drop down” at any point in the Southeast (similar to GoogleEarth’s Street View) and being able to see a 3-D, virtual reality model depicting different points in time. For the first time, land managers could visualize a given landscape based on science and history. The Southeastern Grasslands Initiative is pursuing partnerships with NatureServe and funding from philanthropic and corporate sources to develop "*Grasslandia"*--a portal to a different time and place. The broader impacts of such a program could be a game changer in the world of conservation and education.

207 - Impacts of climate change on the distribution of breeding bird populations in Great Smoky Mountains National Park

Kristin Anderson, Douglas Black, Andrew Laughlin

University of North Carolina Asheville, Asheville, NC

A growing body of evidence suggests that average global temperatures are increasing. In the southern Appalachians, forested regions are seeing higher average temperatures, more severe droughts, and more severe precipitation events. These climatic changes can lead to adaptive responses in some species. In this study, we sought to determine whether changes in climate over the last twenty years have impacted the distribution of breeding bird populations in Great Smoky Mountains National Park. Our expectation was that as temperatures increased, some species would move to higher elevations to remain within their preferred climate envelope. We also expected to see overall declines in some species populations. Researchers from NC State performed breeding bird surveys throughout the GSMNP in the late 1990s. We repeated a selection of these point count surveys in 2018, spanning different elevations. At each point, two researchers recorded all bird species detected aurally and visually over a ten-minute period. Points were placed into three different elevation categories. Ten points were selected from each elevational band for direct comparison between the historical surveys and the counts conducted in 2018. For each elevational band, we measured species richness, species diversity (using Simpson’s diversity index), and compared species composition to historical data. We found a decline in some species across all elevational

bands and shifts in elevation for other species. Further surveys are required for proper analysis of point count data, but preliminary results suggest that of those species that have shifted their distribution, most have shifted upslope and only two species have shifted downslope. Species diversity and richness remain high at all bands.

208 - The Dragons of Mendelia: A synthetic genetic system for teaching transmission genetics.

Kaitlyn Monat, C. Brian Odom

Wingate University, Wingate, NC

"Dragons" is a purely synthetic system for the teaching of the basic and advanced tenants of transmission genetics ie. Mendelian "word" problems, cytogenetics, linkage analysis (and gene mapping) as well as pedigrees and statistical analysis. This extremely low-tech (not computer based) system is very instructor friendly, allowing for rapid changes in genetic attributes from semester to semester to overcome the "hand me down" problem sets answer syndrome.

209 - Adding to our knowledge of molecular phylogenetic relationships of the Rock-Boring sea urchin, *Echinometra lucunter*

Stanton Belford

Martin Methodist College, Pulaski, TN

The molecular phylogenic relationships and genetic structure of Indo-West Pacific, and the Caribbean sea urchin *Echinometra* spp. have been well-studied, however no data for *Echinometra lucunter* has been added from the most southernmost islands of the Caribbean, Trinidad and Tobago. Approximately 10-20 individuals, which included both red and black color morphotypes at various high and low energy environments were collected from Trinidad over a 2 year period. Results from amplified and sequenced 630 bp of the COI region will add knowledge to the phylogeny of *Echinometra* COI sequences, and will notably place this sea urchin's locality within its respective clade.

300 - Identifying Roadkill Hotspots Using a Running Average

Kori Ogletree, Al Mead

Georgia College and State University, Milledgeville, GA

The identification of roadkill hotspots is necessary for planning mitigation strategies to prevent an accumulation of wildlife road mortalities. In a previous study, 178 roadkill specimens were tallied via a driving survey along 21.2 km (13.2 mi) of three connected roadways in Baldwin County, Georgia. Roadkill locations were recorded to the nearest 0.1 mi (0.16 km) using the vehicle odometer. In the current study, the location data was used to generate three graphs that illustrate roadkill distribution: 1) a linear graph of roadkills per 0.16 km (0.1 mi) bin; 2) a linear graph of roadkills per 0.8 km (0.5 mi) bin; and 3) a linear graph with a continuous running average incorporating 0.48 km (0.3 mi). The number and position of the peaks on each graph were compared in relation to roadway features such as vegetative boundaries, stream crossings, hills, and curves. The best visual illustration of roadkill hotspot locations in relation to roadside features is the running average plot. It is a quick and accurate technique to identify hotspot locations and could help resource managers in planning mitigation strategies to decrease wildlife mortality on roadways.

ASB Poster Presentation Abstracts

P1 - Supplemental Instruction at Marshall University

Megan Haffner, Karen McComas

Marshall University, Huntington, WV

Marshall University is in its fifth semester of conducting a pilot program based on the nationally recognized Supplemental Instruction (SI) Program. Both collaborative and co-curricular, SI targets classes—not individuals; SI is implemented in courses that have historically impeded student progress, quantified with high DFW rates. SI emphasizes the duality of content and process in learning to increase student success in the targeted courses, as well as increases resiliency in all future coursework. SI Leaders contribute to these outcomes by targeting the most challenging course concepts and using active and collaborative learning activities in SI sessions. Results from the Marshall pilot program, generated both qualitatively and quantitatively, show a positive correlation between student attendance in at least one-third of SI sessions and final course grade, which corroborate national SI statistics. This poster will introduce the structure and implementation of SI sessions through examples of collaborative learning strategies and activities using the experience of an SI leader for an introductory biology course serving science majors.

P2 - BeATLe Book Groups and Three Books that Changed My Teaching

Darlene Panvini

Belmont University, Nashville, TN

Faculty are invited to participate in a BeATLe (Belmont Applied Teaching and Learning) book group each semester to read and discuss a book related to teaching. The books are provided by the Teaching Center and faculty set their own schedule, committing to meet at least three times during the semester. The interdisciplinary groups provide for an exchange of ideas across subject areas and faculty experiences. Faculty are encouraged to try out new ideas in their courses and report the results to the reading group. Having participated in this opportunity for several years, three books in particular have made a major impact in the teaching approaches used in several of my biology courses. This poster will describe the structure of the BeATLe book groups, books that have most changed my teaching, strategies that impacted student learning, and ongoing attempts to incorporate new ideas from the book groups. Additionally, the benefits of participating in an interdisciplinary book group with other faculty will be described.

P3 - Applying QM Course Mapping to a Traditional General Microbiology Laboratory Course

Dr. Lisa Ann Blankinship

University of North Alabama, Florence, AL

Course maps represent a way to link unit learning goals (objectives) to course learning goals. While this method of presenting goals has been used by education for several years, it is relatively rare to use within the hard sciences. A recent search of the primary literature yielded zero sources on the use of course maps within the biological disciplines, though three sources were found that described mapping of a specific activity to learning objectives. The advent of online learning review systems, such as Quality Matters, utilizes course maps to organize course content in a meaningful and manageable way for online learners. The organization style can be applied to traditional on-campus courses to improve clarity of learning outcomes for students and to link course-learning objectives with Departmental, College, and University level goals. While linking expected learning outcomes to Departmental, College, and/or University level expectations may not be critical for students to understand, it is useful for curriculum review by Department, College, and University review committees and accrediting bodies. The research presented here maps a traditional general microbiology laboratory course using the Quality Matters mapping approach. Each lab has expected learning outcomes for the student mapped to specific skills to be learned during the lab period. The learning outcomes of each lab are in turn mapped to course goals, Departmental goals, College goals, and University core competencies.

P4 - Recruitment and success of majors using a data-driven approach to teaching introductory biology

Christopher Paradise, Malcolm Campbell

Davidson College, Davidson, NC

As teachers, we want our students to think and communicate like scientists. To accomplish this goal, we developed new content of our year-long introductory biology course to be as active as our teaching methods, and published it in a textbook, *Integrating Concepts in Biology* (ICB), that is strongly aligned with the Core Concepts and Competencies of Vision & Change. Use of ICB leads to a DIBS-teaching approach in the classroom, which means putting Data In Biological Science. The DIBS approach emphasizes the central role of data in producing new scientific understanding and engages students in the process of data interpretation and analysis. The approach requires students to engage with data as presented in the scientific literature, and we know from the education literature that people learn best when they construct their own knowledge and retain information better when they connect new knowledge with existing knowledge. We have been teaching this way at Davidson College for 10 years; some colleagues at our institution have adopted our DIBS approach, while others have not, leading to two separate, parallel entries into the major. We have been tracking retention in the major and success in upper-level biology courses based on introductory track. Our analysis suggests that the DIBS approach in combination with using ICB increases retention in the major. Although content and vocabulary are both reduced in the DIBS/ICB introductory biology track, this does not negatively affect the success of students when they move on to upper-level biology courses. An unpredicted benefit from the DIBS approach is that students see a clear connection between class and lab experiences that was not apparent prior to the adoption of the text or the DIBS approach. The DIBS-teaching approach is an active learning strategy that engages students with a focus on the process of science.

P5 - STEM Mia - Integrated approach to enhancing minority student success

Loretta Ovueraye

Miami Dade College, Miami, FL

This presentation will discuss the impact of embedding faculty mentoring, discipline immersions, self-analysis, financial support, toward fostering shaping student perceptions of their personal agency and empowering them to achieve their STEM-related academic and professional goals by helping them connect with the sources of their STEM self-efficacy and identity. What we are accomplishing in MDC serves as a model for two-year colleges seeking to incorporate curricular changes focused on success and retention in biology and computer science majors for populations who are underrepresented in STEM fields in general.

P6 - Developing Scaffolds to Support Undergraduate Students in Learning and Understanding Biological Concepts

Jaime Sabel

University of Memphis, Memphis, TN

The biological field is increasingly interdisciplinary and requires students to build individual concepts into complex understanding of biological systems. It is important to understand how best to support students in this process and provide them with the tools necessary to succeed. Students need support to learn the core ideas, practices, and crosscutting concepts that make up the field of biology so that they can both be successful as biologists and make informed decisions that require biological understanding. One way instructors can support students in these endeavors is to provide students with specific scaffolds to structure their performance of a task or engagement in a behavior until they can do so on their own. I offer a framework and suggestions for developing scaffolds for biology courses, and provide examples of successful scaffolds that we have developed and tested in both majors and non-majors biology courses. In particular, our research group has focused on developing scaffolds to support undergraduate students in engaging in metacognition, non-majors students in reflecting on the importance of biology to their lives and in making decisions that require knowledge of biological concepts, and biology students in learning to appreciate the importance of plants in their studies and their lives.

P7 - Using Polymer Clays to Make Molds and Casts of Fossils for Teaching and Outreach

Jeremy Bramblett[1], Timothy Gaudin[1], Andrew Heckert[2], Marta Toran[2]

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Polymer/polyvinyl chloride clays can be used to make simple, detailed molds and casts of fossils for use in undergraduate biology labs and for public outreach activities. These "make and bake" clays are available in dozens of colors and can be found in most craft stores. Molds and casts made of polymer clays from original fossil specimens or reproductions can be produced within about half an hour or less using nothing more than a small household toaster oven. Most of the fossils that we have molded and cast using polymer clays are relatively small (about 2-5 cm in greatest width). Polymer clays do not require mixing of chemical reagents and are hardened during baking, which takes about 15 minutes for molds and casts that are about 0.5 cm in thickness. These molds and casts are suitable for study and exam materials due to their ability to capture detailed morphology. Importantly, undergraduate students, K-12 students, and the general public can fabricate these polymer clay molds and casts themselves, enhancing "hands-on" activities during labs or public outreach events. The molds and casts can help facilitate discussion of preservation modes of various types of fossils (e.g., body fossils, trace fossils, casts, and external and internal molds). We have made polymer molds and casts of fossil ammonites, brachiopods, bryozoans, corals, dinosaur tracks, echinoderms, gastropods, mammal osteoderms and teeth, plants, reptile osteoderms, shark teeth, stromatolites, and trilobites. This large variety of fossils can also be used to facilitate discussion of geologic time and the temporal distribution of taxonomic groups with students and the public. The polymer clay molds and casts can be painted using soft body acrylics to enhance visibility and aesthetic appeal. Addition of lab and outreach activities using polymer clays can enhance educational value and requires very little investment in materials and time.

P8 - Supporting Students in an Undergraduate Non-majors Biology Course to Develop Self-Efficacy and Metacognition

Katlyn Morris[1], Jaime Sabel[2]

[1]The University of Memphis, Memphis, TN, [2]University of Memphis, Memphis, TN

Although not all students will choose careers in science, all will encounter science in their everyday lives and need a foundation of scientific understanding in order to make informed decisions (NRC, 2012). For many non-majors a college biology course may be the last science course they take. Therefore, supporting students to understand the process of science and see how science is connected to their own lives is important. In this study, we explored how the use of reflection papers supported non-majors students to see the importance of biology in their lives. In particular, we looked at how students developed self-efficacy and metacognition during the semester. Past work has shown that experience within a first-year biology course alone can increase academic self-efficacy (Ainscough et al., 2016), but the individual parts of the course that most contributed to this increase in self-efficacy were not explored. In addition, past work has shown that supporting students to engage in metacognition can help improve their understanding, but this work was focused on students majoring in biology (Sabel, 2017). We used a combination of qualitative self-reporting and quantitative measurements of metacognition. Students in a general elective non-majors biology course completed two surveys that measured their levels of metacognition, and wrote two reflection papers in which they were asked to consider how biology relates to their lives and their careers, and how they know when they understand a biological concept. Qualitative analysis of the surveys suggest that self-efficacy is largely impacted by the student's learning experience both in the past and in the present course. Reflection paper analyses reflect that the degree to which students are aware of their own learning processes varies vastly between individual students. We will report examples of these differences and the impact it has on designing effective courses for non-majors.

P9 - The Young Dragons of Mendelia: an extension of a synthetic genetics system as an outreach teaching system for Mendelian Genetics in middle and secondary schools.

Kaitlyn Monat, C. Brian Odom

Wingate University, Wingate, NC

The Dragons of Mendelia is a synthetic genetics system under development at Wingate University to teach basic concepts of transmission genetics to sophomore level undergraduates. It includes crosses, pedigrees, linkage, cytogenetic and statistical components. This poster will discuss an extremely low-tech extension of this project "Young Dragons" that is directed at various levels in the K-12 school environment.

P10 - Boots on the ground: Experiential learning helps students think critically about their academic pathways

Stephanie Jeffries

NC State University, Raleigh, NC

First-year students arrive at the university facing uncertainty when it comes to mapping out their academic pathways. In the first two years of the Environmental First Year Program, we created an experiential approach using case studies to help students interested in environmental fields explore different pathways. Case studies involve hands-on learning using multidisciplinary approaches. “Wicked problems” engage students’ interests, they learn different approaches toward problem-solving, and they grapple with complexity as they critically evaluate solutions. In addition, students have the opportunity to meet faculty and community members who become stepping stones to further involvement through classes, research, and external learning opportunities. Students’ end-of-semester reflections help them consider their next steps in their academic careers.

P11 - A Distributional and Taxonomic Study of Vicia (Fabaceae) in Alabama.

Eric Minton, Michael Woods

Troy University, Troy, AL

Vicia Linnaeus, commonly known as vetch is a member of the legume family Fabaceae (Leguminosae). The genus consists of approximately 200 species of decumbent or low-climbing annual and perennial herbs which are distributed throughout the temperate portions of the world. Of these, ten species, which consists of both native and introduced taxa, have been reported from Alabama. Based on the results of this study, the most common species of *Vicia* in the state are *V. sativa*, represented in 61 counties, *V. villosa* (57 counties), *V. caroliniana* (49 counties), *V. grandiflora* (45 counties) and *V. tetrasperma* (40 counties). The least common species are *V. hirsuta* (17 counties), *V. minutiflora* (16 counties), *V. lathyroides* (15 counties), *V. ludoviciana* (two counties) and *V. acutifolia* (one county). Dichotomous keys and descriptions are modifications from earlier authors; however, all measurements are based on morphological features of the vegetative and reproductive structures of the plants studied during the project. Data for the distribution maps were gathered from personal collections and plant specimens deposited in the herbaria of Troy University (TROY) and the specimens on loan from the herbaria at Anniston Museum of Natural History (AMAL), Botanical Research Institute of Texas (BRIT), Jacksonville State University (JSU), John D. Freeman Herbarium at Auburn University (AUA), Jacksonville State University (JSU), Samford University (SAMF), University of Alabama (UNA), University of North Alabama (UNAF), University of South Alabama (USAM), and University of West Alabama (UWAL).

P12 - The Genus Galactia (Fabaceae) in Alabama

Haley Odom, Michael Woods

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Galactia, commonly known as milkpea is a member of the legume family Fabaceae (Leguminosae), subfamily Papilionoideae and tribe Diocleae. The genus consists of approximately 110 species of annual or perennial prostrate, ascending, decumbent or erect herbs or low shrubs which occur in the New World, India, China, Indochina, Africa and Australia. Of these, 20 taxa have been reported from the United States, eleven species in the southeastern United States and six species in Alabama. Based on the results of this study, six species of *Galactia* occur in Alabama. The most common species in the state are *G. volubilis* represented in 51 counties, *G. regularis* represented in 23 counties and *G. erecta* represented in 10 counties. *Galactia microphylla* and *G. mollis* are represented in 7 and 5 counties, respectively. The least common taxon is *G. floridana* which is found in only one county. Dichotomous keys and descriptions are modifications from earlier authors; however, all measurements are based on morphological features of the vegetative and reproductive

structures of the plants studied during the project. Data for the distribution maps were gathered from personal collections and plant specimens deposited in the herbaria of Troy University (TROY) and the specimens on loan from the herbaria at Anniston Museum of Natural History (AMAL), Botanical Research Institute of Texas (BRIT), Jacksonville State University (JSU), John D. Freeman Herbarium at Auburn University (AUA), Jacksonville State University (JSU), University of Alabama (UNA), University of North Alabama (UNAF), University of South Alabama (USAM), and University of West Alabama (UWAL).

P13 - Taxonomic Study of the *Clematis reticulata* Walter Species Complex (Ranunculaceae: Subgenus Viorna A. Gray): A Multiple Evidence Approach

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Clematis subgenus *Viorna* is currently recognized as containing 20 species and has undergone numerous infrageneric and interspecific taxonomic treatments within the past century. *Clematis reticulata*, a member of subgenus *Viorna*, is a widespread and highly variable species native to the southeastern and south-central U.S. that has escaped comprehensive study of both morphology and biogeography. Past literature has attributed morphological variation to phenotypic plasticity and clinal variation, but no studies to date have provided quantitative evidence of this claim. Observations of novel characters such as peduncle length, bract position, bract size, bract placement, and leaf characters appear to exhibit morphological discontinuity between ecoregions. We hypothesize that morphological variation, in part, may warrant the recognition of several new narrowly endemic species. A multiple evidence approach is being employed through morphometric analysis of herbarium specimens and common garden plants from natural populations, as well as examination of micromorphological features such as pollen, stomata, and trichomes with SEM. Currently, a total of 65 live transplants from 36 populations of the *C. reticulata* species complex, collected in the past year, are growing in the APSU greenhouse with living duplicates at Mt. Cuba Center. Non-metric multidimensional scaling will be utilized, and characters that separate the species complex into distinct clusters will be compared between herbarium and common garden sets with ANOVA and Tukey HSD. Results will yield better understanding of whether observed morphological variation is taxonomically significant, which may lead to the naming and description of up to 6 new species, the resurrection of 1 historic taxon, and recircumscription of *C. reticulata* sensu stricto.

P14 - Morphological variation within the Hawaiian endemic tree *Planchonella sandwicensis*

Elizabeth Dean[1], Ulf Swenson[2], Stephan Nylinder[3], J. Christopher Havran[1]

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Planchonella sandwicensis (Sapotaceae) is endemic to the Hawaiian Islands and grows in various shapes and sizes across multiple landscapes, and is an amalgamation of six formally described species. Recent unpublished molecular phylogenetic research identifies two distinct entities in Hawaiian *Planchonella*. The most obvious morphological difference between the lineages appears to be the fruit's color: yellow or purple. Further research has been conducted over the last year analyzing the morphological features of the species in search of any other characteristics that may vary between the two entities. Morphological aspects of herbarium specimens from Campbell University, the Swedish Museum of Natural History, and the National Tropical Botanical Garden were quantified and qualified. This has included but is not limited to features such as leaf and petiole length, leaf shape, leaf apex shape, variations of indument, veins, buds, flowers, and fruit shape. All morphological characters vary across the distribution range, but the purple fruited lineage seems to have larger and bluish-green flowers in contrast to the yellow fruited lineage with smaller and pale yellow flowers.

P15 - Arbuscular mycorrhizal fungi communities in soils at different contamination levels of lead (Pb)

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Heavy metal contamination in soils, specifically lead (Pb), is mainly due to anthropogenic sources such as mining, smelting and other industrial activities. Arbuscular mycorrhizal fungi (AMF) are ubiquitous in soils and are commonly found in heavy metal contaminated soils. AMF play a critical role in plant tolerance of excess heavy metals. The main focus of this study was to examine the differences between AMF communities in three select GA soils: Cedartown (2900 mg g^{-1}) ppm, Hickory Grove (290 mg g^{-1}) ppm, and Decatur (90 mg g^{-1}) ppm. For this purpose DNA from soil and roots was extracted and the community of fungal species present in each sample was determined by next generation sequencing (NGS) of the internal transcribed spacer (ITS). Following the NGS, fungal species were identified and separated into operational taxonomic units (OUT's). In total, 22 AMF species were identified and only 2 species of AMF were found at all three sites. The total number of AMF species on each site was not adversely affected by Pb level of soil. The Dice–Sørensen similarity index suggested that AMF communities were dis-similar among sites.

P16 - Comparing ecophysiological traits between two populations of Micranthes petiolaris when grown in a common environment

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[1]Warren Wilson College, Asheville, NC, [2]Clemson University, Clemson, SC

Plant populations respond to environmental cues quickly through plasticity or more permanently through evolution. Drought stress is a common factor that triggers these plant responses. Given the increase in the frequency and magnitude of droughts caused by climate change, it is important to understand how native plant populations may respond to the changing environment. One possible response is the evolution of a drought escape strategy, wherein rapid gas exchange rates enable rapid growth and reproduction prior to the onset of seasonal drought. To determine whether a drought escape strategy may evolve in a montane wildflower species (*Micranthes petiolaris,* Saxifragaceae), we used a common garden approach to compare gas exchange rates between two populations that differ with respect to elevation and exposure to seasonal drought. Photosynthetic rates did not differ significantly between the two populations. However, transpiration rates and stomatal conductance were significantly higher in the population with the lowest water availability during the growing season. Moreover mean instantaneous water use efficiency was significantly lower in this population . Overall, these findings support the hypothesis that the 9X population is exhibiting a drought escape life history strategy and the observed phenotypic differences between populations are genetically based.

P17 - Characterizing the Grease on Greasegrass (*Tridens flavus* L.)

Katie Horton, Tom Diggs, Clarke Miller

University of North Georgia, Oakwood, GA

Tridens flavus L., commonly called purpletop or greasegrass, is a perennial in the grass family (Poaceae) that can be identified by the purple flowering plumes it produces each fall as well as by the greasy substance it secretes during the same time period. This project seeks to use commonly available tools for analysis of organic compounds to discover the identity and makeup of the grease that the grass is named for.

P18 - Analysis of Volatile Organic Compounds of *Calycanthus floridus* and *Calycanthus brockiana* Using Combined Gas Chromatography and Mass Spectroscopy

Abigail English, Tom Diggs, Clarke Miller

University of North Georgia, Oakwood, GA

This project seeks to characterize the volatile organic compounds found in *Calycanthus* using headspace sampling and look at their variation among different populations of the plant. *Calycanthus floridus* is an aromatic, highly variable shrub native to the United States' east coast. The terpenoids and alkaloids present in this plant have been studied as far back as 1888, and mechanisms have been found for laboratory synthesis of its alkaloids (Collins & Halim 1971, Xu & Cheng 2015). However, little research has been done into specifically volatile compounds found in the plant or their variation between populations. This project will use headspace sampling and GC/MS analysis to isolate and identify volatile compounds from different populations of *C. floridus* and which may also be used to establish the amount of variance the plant's compounds show. Compounds will also be analyzed for one individual of *C. brockiana*, a closely related plant which is currently considered a separate species endemic to north Georgia, to examine how its volatile composition compares to the *C. floridus* populations. We expect that in addition to providing valuable chemical composition information for this plant, the volatile metabolite characterization may provide information for taxonomic classification.

P19 - The Phytoremediative Effects of *Coriandrum sativum* in Lead Contaminated Soil

Sierra Garrett, Timothy Trott

Southern Adventist University, Collegedale, TN

Environmental exposure to heavy metals such as lead poses a significant health threat. The goal of this project was to evaluate the effectiveness of *Coriandrum sativum* (Cilantro) as a potential lead (II), Pb^{2+}, phytoremediator. *Coriandrum sativum* plants were allowed to grow for 43 days while exposed to with different amounts of lead nitrate, $Pb(NO_3)_2$. Lead exposure was accomplished by regular watering with a concentration series of lead nitrate solutions. The roots and shoots of these plants were separated and dried. Ground plant material was liquefied by nitric acid digestion. The amount of lead absorbed by each plant sample was determined by Flame Atomic Absorption Spectrometry (FAAS). A Kruskal-Wallis test found a significant difference between the amounts of lead detected in the plants of the four treatment groups. This difference existed both in the roots and shoots of the *Coriandrum sativum*. The results of this study show that greater lead exposure yielded greater lead absorption in *Coriandrum sativum*. This supports that *Coriandrum sativum* effectively absorbs lead from the environment. Further studies and refined exposure series are needed to increase statistical validity and confirm *Coriandrum sativum*'s phytoremediative potential.

P20 - Adaxial and Abaxial Absorption of Light and the Influence on Gas Exchange in Holly

Kathyrn Young, Anthony Percival, Liliana Rangel-Parra, Howard Neufeld

Appalachian State University, Boone, NC

Leaves of most plants are more reflective from their abaxial (bottom) than adaxial (top) surface, for reasons not yet fully understood. Light entering a leaf from the adaxial side must first traverse the upper epidermal layer, then the palisade mesophyll, before entering the lower region of a leaf that contains irregularly shaped spongy mesophyll cells. Studies also show that most chlorophyll in a leaf is contained in the upper palisade layer, where most photosynthesis occurs. Columnar-shaped palisade mesophyll cells, which act as light pipes, allow light penetration to spongy mesophyll cells, which effectively scatter light due to their irregular shape. Light entering abaxially is fundamentally different from light entering adaxially. Such light first encounters the abaxial epidermal layer, which is more reflective, and then impinges upon spongy mesophyll before traveling to palisade cells. This reverse entry may reduce the amount of light reaching the palisade mesophyll because of increased reflectance and because increased scattering by spongy mesophyll directs less light to palisade cells. This suggests that at equivalent PAR, rates of gas exchange should be lower when light enters abaxially, due to reduced absorbance by chloroplasts, especially in the palisade layer. It might also reduce photosynthesis because spongy mesophyll cells are more sensitive to high light and become photoinhibited. To test this, we measured gas exchange at saturating PAR for leaves of holly (*Ilex x 'Nellie R. Stevens'*± 0.1 μmol m^{-2} s^{-1} (p = 0.012) for leaves oriented upside down, partially confirming our hypothesis. We plan to measure reflectances of both leaf surfaces and PAR response curves for leaves in normal or inverted orientation. The results of these studies should provide additional information for elucidating why reflectances are greater for abaxial than adaxial leaf surfaces in plants.

P21 - Is oak mistletoe host species distribution the result of the correlation between seasonal patterns of host tree growth and mistletoe phenology?

Christopher Randle, Tyler Bates, Kelsey Bond, Reagan King, Andrew Martinez, Nicholas Reger, Sana Sadiq, Ashlan Walker, David Warren, Donovan Haines

Sam Houston State University, Huntsville, TX

Oak mistletoe (*Phoradendron leucarpum*) relies on host plant cues for successful orientation of the emergent radicle toward the host stem and haustorial establishment. In particular, monoterpenes, a class of volatile organic compounds that are commonly emitted by plants as a byproduct of metabolism, have been shown to have a positive effect on the orientation of emergent mistletoe radicles. Further, radicles of mistletoe seedlings planted on cut branches grow toward living branches, even when there is no physical contact between the radicles and living branches. These results suggest that the emission of monoterpenes around the time that mistletoe seedlings have been placed on branches *in situ* may be an important determinant in which species are parasitized in a given area, and which are not. Red maple (*Acer rubrum*) and sweetgum (*Liquidambar styraciflua*) have been recorded as hosts in other parts of the range of *P. leucarpum* but not in a survey of trees in Walker County, Texas, though they occur there. Conversely, prominent mistletoe hosts of Walker County include water oak (*Quercus nigra*) and callery pear (*Pyrus calleryana*), which are not as frequently parasitized in other parts of the range. In this study we tested the correlation between phenology of mistletoes and their local hosts, through assessment of fruit availability and seedling viability over time, timing of host-tree bud break, host tree emission of monoterpene gases, and mistletoe seedling growth responses to gases not previously tested.

P22 - Rapid Measurements of Gas Exchange in an Evergreen Angiosperm: Plant and Gas Exchange System Responses to Rapid Changes in Environmental Parameters

Liliana Rangel-Parra, Anthony Percival, Erica Pauer, Kathyrn Young, Fernando Alejo-Vann, Howard Neufeld

Appalachian State University, Boone, NC

In the Eastern United States, many days are characterized by variable cloud cover that results in fluctuating environmental conditions. As clouds cross in front of the sun, the frequency of these fluctuations changes abruptly, on timescales anywhere from hours to seconds. Since stomatal opening and closing occur on minute timescales, environmental conditions may change more rapidly than stomata are capable of responding. This holds important implications for gas exchange, but for technical reasons in the past, has not been well studied on fine timescales. Most diurnal studies record plant responses at hourly intervals, which miss subtle responses occurring at smaller time intervals. With the advent of modern gas exchange systems, it is now possible to measure leaf responses to environmental fluctuations at timescales on the order of seconds. We hypothesized that leaves fully induced by high light would be able to respond quickly to rapid light fluctuations with respect to photosynthesis, whereas stomatal movements would lag behind and oscillate moderately, but never achieve equilibrium. We measured gas exchange at 2 sec intervals over several days on the ornamental holly *Ilex* x 'Nellie R. Stevens' to test our hypothesis and to determine whether the Li-6800 gas exchange system can measure leaf responses at such rapid rates. In January, when temperatures were above freezing (4.2 to 10°C), photosynthesis, stomatal conductance and water use efficiency all had similar coefficients of variation, indicating equivalent variation during a period of rapidly changing light conditions. Thus, our hypothesis is rejected, at least for this time period. We will continue to make similar measurements through the spring as temperatures warm to see if our hypothesis holds under conditions more favorable for leaf gas exchange. Understanding plant responses to rapidly fluctuating environmental conditions will help us develop better models of gas exchange and responses to future climate change.

P23 - Discovery and Restoration of a Forgotten Garden

Noel Cawley

Lincoln Memorial University, Harrogate, TN

This garden is located at Pine Mountain Resort State Park in Kentucky and is believed to have been originally constructed by the Civilian Conservation Corps in the 1930s. It sits on a sandstone cap and consists of 56 beds of various sizes. The garden runs from east to west and has north and south

facing aspect. The north facing aspect is dominated by *Tsuga Canadensis* and the south facing aspect by hardwoods. There is also a water feature that directs the water flow through the garden and consists of several pools at different elevations. A map of the garden was created for the Pineville Garden Club; in it is marked species of interest. Species listed include several that are in the orchid family including *Habenaria* and *Cypripedium*. Work that is presently in place or will soon be initiated is 1) plant list of species listed in the garden map (map has common names and/or genus names), 2) creating a book that has the characteristics of the plants listed on this map (this is being performed by my field botany class), 3) abiotic data on the sites including light infiltration levels, soil moisture, soil organic matter content, and soil depth will be collected this spring, 4) survey of herbaceous plants in the understory of the garden, 5) removal of *Microstegium vimineum*. The goal of this project is to restore native species with an emphasis on ephemeral species in this garden. Other native species not listed in the garden may be part of the restoration plan. Greatest threats to the success of this goal are maintaining an interest in the garden and the presence of *Microstegium vimineum*.

P24 - A flora of the vascular plants of Pine City Natural Area (Monroe Co., AR): the importance of a flora for conservation priorities

Diana Soteropoulos, Travis Marsico

Arkansas State University, Jonesboro, AR

Due to biodiversity loss, it is imperative to document current community composition for conservation and preservation of ecosystems. A baseline of defining plant communities consists of developing a list of vascular plant species present in a defined unit area (i.e., a flora). Eastern Arkansas in the Mississippi Alluvial Plain (MAP) ecoregion has historically been under-collected floristically, including the ecologically unique site Pine City Natural Area (PCNA). PCNA is home to the only Red-cockaded Woodpeckers in the MAP ecoregion, one of only two areas with naturally occurring loblolly pine (*Pinus taeda*) known from the MAP, and the only known saline barrens outside the West Gulf Coastal Plain ecoregion in Arkansas. Only 51 voucher plants representing 40 species had been collected from PCNA prior to this research. Here, we document one year of plant collection information for a two-year flora being conducted at PCNA from 2018-2019. In 28 site visits, 978 additional voucher specimens were collected, 533 unique taxa identified, and 157 county records found, including 16 state-rare taxa tracked by Arkansas Natural Heritage Commission and a species not seen in this ecoregion since the 1920s, *Liatris hirsuta*. It is astounding that ~30% of our collections represent county records when considering that PCNA represents 0.26% of the land area in Monroe County. In addition to documenting the species present at PCNA, we will use this flora and others from Arkansas to analyze the impact of a floristic survey on understanding the impact of a floristic survey. Aside from the addition of new county records, a flora can provide information about which areas have higher conservation concern and validate the importance of the time and effort to conduct a systematic survey.

P25 - Soil crust algal communities of Warren Prairie Natural Area, Arkansas

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Warren Prairie Natural Area in Bradley and Drew Counties, Arkansas, is a strange mosaic of saline slicks that form flat, crusty depressions in a central area with a zone of lichens and a few rare angiosperms, and an outer zone of cyanobacterial mats. The edges of the saline slicks are home to the rare, diminutive vascular plant, *Geocarpon minimum* Mackenzie (Caryophyllaceae), which is a federally protected threatened species. The main objective of this project is to characterize the soil crust eukaryotic algal communities from two sites in Warren Prairie Natural Area using morphological and molecular techniques. We have characterized strains isolated from samples collected in February, 2016 and December, 2017. The eukaryotic algae of Warren Prairie slicks are highly diverse and include taxa from the Trebouxiophyceae and the Chlorophyceae (Chlorophyta), the Zygnematophyceae and the Klebsormidiophyceae (Streptophyta), and the Eustigmatophyceae and Xanthophyceae (Stramenopiles). Most of the genera are widely distributed in many types of soil, but a number of new species are present. Several strains represent new records for North America or the U.S. Our results show that the unusual chemistry of the barrens soil of Warren Prairie harbor unusual algae in addition to rare plants.

P26 - Checklist of the vascular flora, restoration plans, and educational interpretive signs for a remnant prairie at the Lakewood Memorial Cemetery, Hinds County, Mississippi

Olivia Shelton

The University of Southern Mississippi, Hattiesburg, MS

A floristic survey was conducted on the eastern margin of the Lakewood Memorial Park Cemetery, located between Jackson and Clinton, Mississippi, near the western edge of the Jackson Prairie ecoregion. From soil map data and preliminary observations of the land form and flora, the eastern part of the cemetery was hypothesized be remnant prairie now mostly covered in exotic grasses (pasture) and woodland. Plant specimens were collected, identified, and preserved in the USMS herbarium. Typical prairie plants included *Asclepias virdiflora*, *Echinacea purpurea*, *Paspalum dilatatum Rudbeckia hirta* and some of the associated woodland had rare species such as *Carya myristiciformis* (nutmeg hickory). Plants with a historical medical significance were also noted. Due to the scarcity of prairies in Mississippi, land owners were petitioned to restore the prairie by burning and removal of non-native shrubs and trees and to place an educational interpretive sign about the prairies and the Jackson Prairie, in particular.

P27 - The Ronald L. Jones and Ralph L. Thompson Herbaria at Eastern Kentucky University

Nick Koenig[1], Calvin Andries[1], Thomas McFadden[1], Bailey King[1], Robert Pace[1], Brad Ruhfel[2]

[1]Eastern Kentucky University, Richmond, KY, [2]University of Michigan, Ann Arbor, MI

The Eastern Kentucky University (EKU) Herbaria are located in a new, state-of-the-art facility and contain the largest collection of vascular plants in Kentucky and the second largest in the Kentucky-Tennessee region. Since the inception of the EKU Herbarium in 1974, and especially with the merging of the EKU and Berea College collections in 2018, these herbaria have been an integral resource for biological research. Most specimens are from central and eastern Kentucky, but also there is good representation of western Kentucky and the southeastern United States. There is also a set of woody plant specimens from Costa Rica. A number of important sets of specimens are housed in the Ronald L. Jones Herbarium (EKY), including sets from EKU's natural areas (Lilley Cornett Woods, Maywoods Environmental and Educational Laboratory, and Taylor Fork Ecological Area), Pine Mountain, Breaks Interstate Park, Brodhead Swamp, the headwater regions of the Green River, and the Red River Gorge. Important collectors include M. Wharton, E.T. Browne, R. Athey, R. L. Jones, and the staff of the Office of Kentucky Nature Preserves. The Ralph L. Thompson Herbarium (BEREA) includes specimens from several published floras, especially of surfaced mined lands. Important collectors include J. R. Abbott, R. A. Gelis, J. D. Pittillo, D. D. Taylor, and R. L. Thompson. As of December 2018, the EKU Herbaria include over 100,000 specimens, all of which are imaged, databased, and available online (http://sernecportal.org) thanks to a recent grant from the National Science Foundation. The purpose of this poster is to provide 1) a visual guide to the taxonomic and biogeographic distribution of specimens in these collections, 2) a brief history and explanation of the important collections and publications, and 3) a summary of future projects.

P28 - Making a Large Impact on a Small Herbarium: The Impacts of an NSF CSBR Grant on a Regional Herbarium

John Schenk, Andrea Appleton, Colleen Evans, Maggie Kuhn

Georgia Southern University, Statesboro, GA

Regional herbaria are known for their value in holding the best representation of their respective local floras; however, they often operate without an annual budget, generating massive backlogs and hindering the impact that they could otherwise make. Such was the case with the Georgia Southern University Herbarium (GAS), in which over half of its collection was unmounted, unaccessioned, and unavailable for research and teaching. Through a National Science Foundation Collections in Support of Biological Research Grant, GAS has experienced substantial changes in its ability to curate and protect specimens. More importantly, our herbarium has also increased holdings of accessioned materials. Over the last three years, the collection has grown from 21,127 to 43,143 specimens, with numerous specimens continuing to be processed on a daily basis. The collection's regional focus remains in the Georgia Coastal Plain, one of the most understudied yet biologically diverse ecosystems in Georgia. The grant further provided opportunities to update the nomenclature, replace

deteriorating folders with archival-quality folders arranged geographically, and better engage students and the public through teaching modules. Digital images and data of the specimens have also been made widely available and searchable through the SERNEC portal (http://sernecportal.org/portal/).

P29 - Identification of moss species at Wingate University Campus Lake in Wingate, NC

Emily Barbee, Christy Carter

Wingate University, Wingate, NC

Moss diversity at Wingate University's Campus Lake in Wingate, Union Co., North Carolina, was investigated in different habitats in order to determine which species of moss were present. Walk-throughs of randomly sampled forested areas, open areas, and nature trails throughout the approximate 4.9 ha site from September through November 2018 provided specimens for identification. Mosses (with or without sporophytes) were individually placed in plastic collection bags and stored in the dark at room temperature until identification. Moss samples were rehydrated in Petri dishes and examined using a Motic® dissecting microscope. Pictures, when captured, were taken with a Motic® Moticam X3 Wi-Fi camera in order to aid in visual identification. Taxa were determined using McKnight *et al*. (2013) and *Flora of North America North of Mexico* vols. 27 and 28 (Flora of North America Editorial Committee 2007, 2014). Nomenclature followed *Flora of North America North of Mexico*. Identification labels were included with each specimen once they were identified. Thirty-eight moss specimens were collected and at least twenty-one species from seventeen genera have been identified to date. Four species were found within the genus *Dicranum* whereas most genera were represented by a single species. Identification of the remaining seventeen species is ongoing. Species identified include: *Brachythecium rutabulum* (rough foxtail moss), *Bryoandersonia illecebra* (worm moss), *Brotherella recurvans*, *Calliergon cordifolium* (heart-leaved spear moss), *Dicranum majus* (greater fork moss), *Dicranum* sp. (unidentified #1), *Dicranum* sp. (unidentified #2), *Dicranum* sp.(unidentified #3), *Ditrichum pallidum* (saffron moss), *Ditrichum* sp. (unidentified #1), *Entodon seductrix* (cord glaze moss), *Heterophyllium affine* (southern gloss moss), *Hygroamblystegium varium* (tangled thread moss), *Leucobryum albidium* (pincushion moss), *Leucodon brachypus* (leucodon moss), *Polytrichum commune* (common haircap moss), *Rhynchostegium serrulatum* (beaked comb moss), *Schwetschkeopsis fibroma* (rapunzel moss), *Thamnobryum alleghaniense* (shrub moss), *Thuidium delicatulum* (delicate fern moss), *Ulota crispa* (crispy tuft moss).

P30 - Continued Efforts to Approximate the Flora of Tater Hill Plant Preserve

Danielle Privat, Matt C. Estep, Andrew P. Jenkins

Appalachian State University, Boone, NC

Several studies have been conducted to document the flora of Tater Hill Plant Preserve in Watauga County, North Carolina. Early studies focused on the mountain bog communities within the preserve, but failed to adequately sample upland sites. Over the last decade the preserve has also grown tenfold in size and incorporated several novel plant communities including High Elevation Grasslands, *Crataegus* forests, Birch Boulderfields, and High Elevation Rock Outcrops. Rich Mountain is part of the plant preserve and is considered part of the Amphibolite Mountain Macrosite, a geologically unique region that differs from the rest of the Blue Ridge, creating a hotspot of plant diversity. Within this region, high quality recent floristic inventories exist for Three Top Mountain Game Land Preserve and Mt. Jefferson State Natural Area. These sites have comparable plant communities due to the geology and geographic proximity. This study aims to expand the current flora of Tater Hill by comparing our current list of taxa with previous studies to generate a list of "missing" taxa that are likely to be observed on the plant preserve, and focusing on the vegetation that occurs above the bog.

P31 - Preliminary analyses of the flora of Grandfather Mountain

Ethan Hughes

Appalachian State University, Boone, NC

Grandfather Mountain (GM), the 13th highest peak in eastern North America, and a UNESCO International Biosphere Reserve, has a unique assemblage of natural communities and rare taxa with many species that occur more commonly in the northeastern US and Canada. GM has generated botanical interest for over 250 years, with a number of prominent botanists visiting GM and

discovering new plant species in the 19th century. These early botanical explorers noted the similarities of its spruce-fir forests to those in Canada and the northeastern United States and these observations ultimately led to greater understanding of biogeographical relationships of the flora of the Southern Appalachians. Our study examined botanical collectors at GM during the 19th century who made significant contributions to our understanding of the flora on the mountain. Our investigation of herbarium specimens in the SERNEC database identified four botanists that provided early plant records and data for plant taxa occurring on GM. Asa Gray, Rev. Moses A. Curtis, John K. Small, and Amos A. Heller contributed to our understanding of the flora of GM and the rare plant taxa occurring on the mountain. Each of these men were not only important in describing the flora of GM, they also contributed extensively to our understanding of the flora of the southeastern United States, the western United States, and the North American continent. We have also begun a study to characterize the flora of the Boone Fork drainage within Grandfather Mountain State Park (GMSP), using both floristic habitat sampling and Carolina Vegetation Survey plots to document the vascular and non-vascular flora of the roughly 1000-acre area northeast of the 5,946ft peak of GM. We will report on these preliminary studies and provide a historical overview of the early botanical research on GM.

P32 - The Growth and Digitization of the Campbell University Herbarium

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The Campbell University Herbarium (CAU) was founded in 2011 and is located in Harnett County, North Carolina on the border of the Piedmont and Coastal Plain. The herbarium has been able to actively grow through student collections, research vouchers, and exchanges with national herbaria. The collection contains vascular plants from across the United States, with particular emphasis on woody trees and shrubs of central North Carolina. Currently, the herbarium contains about 5,100 accessioned specimens. In 2017, the herbarium began digitizing through the Southeastern Regional Network of Expertise and Collections (SERNEC). At Campbell University, this process initially started using a mobile digitization rig from North Carolina State University. About 4,700 specimens were digitized in winter of 2017. Newly accessioned specimens are transported to the North Carolina State University herbarium to be digitized by Campbell University research students. Transcription of specimen data is accomplished by student researchers. Currently 28% of accessioned specimens are georeferenced. Images and skeletal geographic data for about 4,900 specimens digitized to date are available through the SERNEC portal. Student interest in the herbarium's growth and digitization continues to fuel the enhancement of herbarium's collections.

P33 - Using digitized herbarium specimens to predict the potential distributions of Tennessee's historical plant species

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With new developments in museum-based informatics, herbarium specimens have been recognized as records of fundamental importance for biodiversity analysis and management. Herbaria contain vast amounts of information on species distributions in the form of specimen-based occurrence data. Recently, as herbarium collections have become more accessible via electronic databases such as the Southeast Regional Network of Expertise and Collections (SERNEC), specimen-based occurrence data have been used as a tool for understanding species distribution patterns. One application is the use of occurrence data as input for species distribution models, allowing us to disentangle complex distribution patterns by integrating known species occurrences with meaningful environmental variables that influence their distribution. This application could serve as a critical tool in studies of rare species in order to guide field searches for unknown populations as well as identify suitable areas for the restoration or reintroduction of such species. This study focuses on using occurrence data from the SERNEC database along with a machine learning technique called Maximum Entropy Modeling (MaxEnt) to model the potential distribution of Tennessee's historical vascular plant species. There are 23 species listed as historical in Tennessee. The last date of observation for these species ranges from 1884 to 1989. In August 2018, a SERNEC database search revealed a total of 14,459 occurrence records, in 46 states, for species considered historical in Tennessee. Analysis of these specimens revealed only 162 records, representing 16 of the 23

historical species, were collected in the state across 24 counties. The goal of this study is to demonstrate the use of herbarium specimen data paired with MaxEnt to model the potential distribution of Tennessee's historical vascular plants and possibly guide the rediscovery of previously unknown populations.

P34 - An Overview of the Catawba College Herbarium (CATU) Located in the Central Piedmont of North Carolina

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Catawba College, Salisbury, NC

Catawba College was founded in 1851 in Newton, NC, and moved to its current location in Salisbury, NC, in 1925. The college herbarium is part of the Department of Biology and was established in the 1930s. The Catawba College Herbarium is listed in Index Herbariorum by the herbarium code, CATU. The curator is Professor Emeritus Michael J. Baranski who is supported by undergraduate herbarium technicians. The herbarium has strengths in the floristics of the Rowan County area and the central piedmont of NC, with emphases on notable areas including the Sandhills, the Uwharrie Mountains, and Catawba College's own Fred Stanback Jr. Ecological Preserve which is a North Carolina Natural Heritage Program- Significant Natural Area. GIS analyses of the existing herbarium database will demonstrate the collecting effort on a per county basis in NC, by US state, and by collector. Currently the herbarium contains over 4,500 databased specimens of vascular plants. Plans for the future of the herbarium include converting the MS Access database to Specify Software with the goal of integration into the SERNEC (SouthEast Regional Network of Expertise and Collections) data portal and initiation of imaging of specimens. The Catawba College Herbarium represents an important repository of floristic biodiversity data in a rapidly urbanizing area.

P35 - Using Confocal Microscopy to Compare Arbuscular Mycorrhizal Fungi Associations in Two Riparian Species, *Salix nigra* Marshall and *Platanus occidentalis* L.

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Riparian plant species play an important role in maintaining the waterways they surround. Previous research in our lab has indicated that two important riparian tree species of our area Black Willow (*Salix nigra* Marshall) and American Sycamore (*Platanus occidentalis* L.) may differ in the levels of colonization and in the nature of the interaction by arbuscular mycorrhizal fungi they experience. Arbuscular mycorrhizal fungi (AMF) have a symbiotic relationship with many plant hosts and may contribute to nutrient (mainly phosphorus) and water uptake, and may even protect their host plants against pathogens. In exchange, AMF receive photosynthetic products from their hosts. Despite the importance of these mycorrhizal associations, little is known about the plant-fungal interface at the cellular level. Therefore, we are using the confocal microscope to investigate the biology of this interaction. The confocal microscope can allow for the determination of cellular structure and morphology of the mycorrhizae and plant root. The fundamental attribute of confocal microscopy is that it permits optical sectioning rather than mechanical sectioning of the specimens using fluorescence and reflection imaging. As a consequence, the resulting images have a better resolution and contrast than with a conventional light microscope. Digitized confocal images may be further improved into 3-D reconstruction to allow for better understanding of the association of mycorrhizae and host. The purpose of this project is to establish a methodology that will allow us to compare the surface area of contact between AMF and plant roots using the confocal microscope. We have determined that both Trypan Blue and acid fuschin dye can be used to stain tree roots and we have been able to produce images of AMF in both plant species. Our next objective will be to generate 3-D z-stacks to measure surface area of contact between the two species.

P36 - Fungal Microbiota Richness and Abundance Found in Conventional Versus Organic Farming Techniques

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Farming techniques used on vegetable crops are believed to influence the health of the soil and microbiota contained in the soil. The purpose of this study was to determine the abundance and richness of fungal microbiota found on farms using both organic and conventional farming techniques. The composition of soil from four farms (two organic and two conventional) in the Bluegrass Region of Kentucky was sampled and tested for fungal species during the months of May 2018 to July 2018. To identify any fungal microbiota that may be in the soil samples, dilution of samples, subsampling, and microscopic visalization with lactophenol cotton blue were used to make positive identifications of each sample. These soil samples contained six species of fungi in the organic farms: *Aspergillus niger, Clabophialophora* species, *Cunningamella bertholletiae, Aspergillus variabilis, Mucor* species and *Aspergillus clavatus*; and four species of fungi in conventional farms: *Zygomycetes*species, *Schedoporium profilicans, Anthridium phaespermum,* and *Aspergillus clavatus.* These results show that there is a difference between the abundance and richness of fungal microbiota found on both organic versus conventional farms.

P37 - Potential Transmission of Snake Fungal Disease Through Wooden Box Traps in Biodiversity Study

Brandon Jack

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Snake Fungal Disease (SFD) is caused by an emerging fungal pathogen, *Ophidiomyces ophiodiicola.* Since 2006, massive declines in several snake populations have been documented across the eastern United States. *O. ophiodiicola* is a keratinophilic pathogen that can cause open wounds or scar tissue along the body, head, or tail, though not all cases of infection have visible symptoms. One study saw a 40% mortality rate in five Cottonmouths (*Agkistrodon piscivorus*) inoculated with the pathogen, however, little has been done to determine the potential human involvement in the transmission of *O. ophiodiicola*. A widely accepted method for sampling snake populations is drift fences with wooden funnel traps. This method was used to survey the snake populations in Paulding and Sheffield Wildlife Management Areas in Northwest Georgia which had not been used in this area previously. The purpose of this research was to test if these traps could be potential reservoirs for the fungal pathogen. With any wildlife disease, we need to determine the unintentional risk of transmission from infected animal to a non-infected animal due to sampling methodology. Six drift fences with two box funnel traps made of pressure treated wood were used to sample the snake populations. Sterile swabbing was performed on three occasions inside the boxes while the traps were actively being used to trap snakes. The swabs will be tested using PCR and qPCR methods to determine presence or absence of *O. ophiodiicola*. We predict that the traps will be unable to act as a reservoir for *O. ophiodiicola* because the traps' materials do not contain keratin; therefore, wooden box traps typically used in drift fence arrays to catch snake species will not further transmit SFD. We anticipate that this study will help establish protocols to prevent human caused transmission of SFD.

P38 - Role of Bacillus subtilis in Polyester Degradation

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The microbiome that exists on the human skin in the axillary region contributes to malodor. Many have suggested that there are three major genera that contribute to clothing malodor: *Corynebacterium, Micrococcus, and Staphylococcus*. These bacteria are commonly found on the skin. However there are also bacteria on textiles. The microbiome of the skin, and therefore the microbiome associated with malodor, will include bacteria from the textiles we wear. Bacterial communities from unworn and worn polyester garments were compared by 16 S rDNA sequencing; 10 Bacillus species were shared on both sample types. These bacteria were isolated and grown on media containing the polyester chemicals Hydroperm T and Polyethylene Glycol 1450. Results demonstrate that many of the bacillus strains can grow on each component with the addition of artificial sweat. These findings suggest the bacteria can either grow in the presence of polyester or metabolize polyester. The components of polyester contain repetitive ester and ether linkages. Hydroperm T in particular contains ester linkages to aromatic rings creating a polyaromatic compound. There are few known enzymes that are capable of breaking these synthetic compounds, categorized as esterases and lipases. A carboxyl esterase was identified in *B. subtilis* isolated from polyester clothing. The gene encoding this protein was inserted into pET21 and the esterase protein was recombinantly expressed and characterized in *Escherichia coli*.

P39 - Fomites in the Fitness Center: Fitness Equipment Harbors Antibiotic Resistant and Pathogenic Bacteria

Dawn Simms, Pierce Prevost

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Local fitness centers were surveyed for the presence and abundance of pathogenic bacteria with a specific focus on World Health Organization (WHO) priority pathogens (e.g., fluoroquinolone-resistant *Salmonella*, MRSA, and vancomycin-resistant *Enterococcus*). Fitness centers offer a unique opportunity for investigating the presence and abundance of pathogenic bacteria in the environment, as these facilities are used by persons with varying levels of personal hygiene routinely sharing equipment via frequent and direct surface-to-skin contact. Inanimate surfaces (i.e., fomites), such as workout equipment, are disregarded by many as potential bacterial reservoirs. However, fomite survival is a very important aspect of pathogen transmission. Other studies have focused on limited types of bacteria present or absent. This study also aimed to quantify the amount of bacteria which can be found in fitness centers. Three fitness centers were chosen based on their varying levels of typical foot traffic (i.e., low, medium, and high). Samples were taken from barbells, chest fly machines, and dumbbells and used to determine overall bacterial load, presence or absence of pathogenic bacteria, and which (if any) of those bacteria were priority pathogens and/or antibiotic resistant strains. Selective screening was done via selective and specialized growth media. Species identification was confirmed by performing API chemical panels on successfully isolated colonies and comparing the results to those listed in the analytical profile index (API), crossed-referenced with Bergey's Manual of Determinative Microbiology and the D-Bite Database. Bacterial loads were such that even the lowest bacterial load was several billion cells (the highest was tens of trillions of cells) with no correlation to the levels of foot traffic or type of equipment sampled. Fluoroquinolone-resistant *Salmonella enterica* was found in 22% of samples, *Edwardseilla tarda* in 55% of samples, and 100% of samples tested positive for methicillin-resistant *Staphylococcus aureus* (MRSA).

P40 - Effect of cosmetic preservatives on the growth, biofilm formation, and the gene expression of *Staphylococcus epidermidis*1457

Audrie Campbell, Esther Choi

Union University, Jackson, TN

Mammalian skin contains a variety of microbial organisms that now we know have beneficial roles on the host. Skin bacteria produce antimicrobial peptides, restrict other incoming pathogens, and interact with host cells under the skin. The interplay of normal microbiota and host seems to be an important factor for maintaining healthy skin condition. Our skin, however, is often subject to many treatment and environmental stress which cause changes in the numbers and the types of skin microbiota. In fact, there are growing concerns of synthetic preservatives in cosmetics in that matter. Many cosmetic products have switched their preservatives to more natural options, such as seed oil and extracts. In this study, we aimed to compare adverse and beneficial effects of synthetic versus natural preservatives in cosmetics. One of the most common skin microbiota, *Staphylococcus epidermidis* 1457 behaving both as a commensal and an opportunistic pathogen, is treated with propylene glycol, propyl paraben, and seed extract. We are under investigation to detect the effect of compounds on the bacterial growth, metabolic activity, and gene expression involved in biofilm formation. In addition, a skin epithelial cell line A-431 is being treated with the compounds to detect any changes in important proteins and cytokines involved in skin innate immunity. Our work can provide a direction for developing future targeted preservatives in cosmetics that provide product safety and minimize any unwanted changes in skin microbiota and the host cells.

P41 - Detection and Characterization of Biosurfactants Produced by Marine Bacteria

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Biosurfactants are microbial produced amphipathic molecules that serve as a green alternative to surfactant use in industry, agriculture, and most notably, bioremediation. Biosurfactants are structurally diverse with the most common being glycolipids. As amphipathic molecules, biosurfactants have the capacity to decrease surface tension and interact with charged compounds. The aim of this project is to characterize the biosurfactants produced by marine bacterial species

isolated from ocean invertebrates. The organisms explored included *Kistimonas asteriae*, *Kistimonas scapharcae, Kistimonas alittae,* and unidentified bacterial isolates. Biosurfactant production was analyzed by measuring surface tension. Production of biosurfactant was evident based on decreases in surface tension. To ascertain the ionic nature of the biosurfactant, a double diffusion assay and a Cetyl Trimethyl Ammonium Bromide (CTAB) methylene blue assay were performed. The double diffusion assay was done by placing aliquots of whole cell culture, cell supernatant, and sterile solutions of 20 mM SDS, 20 mM CTAB, and 50 mM $BaCl_2$ into wells made in 1% agar gels. Precipitation lines between the cell samples and the charged solutions indicate ionic characteristic of the biosurfactant. Precipitation lines were observed at 24 and 48 hours. Precipitation lines were observed between the CTAB and the cell samples indicating that the biosurfactant is anionic in nature. These results were compared to the positive control *Pseudomonas aeruginosa* which produces the anionic rhamnolipid biosurfactant. The CTAB methylene blue assay was performed by inoculating bacteria on a mineral salt media with 0.05% CTAB, and varying amounts of methylene blue. Bacterial cultures were observed at 24 and 48 hours. A dark blue halo formed indicates the presence of anionic biosurfactant. Future studies will include optimizing media to provide higher biosurfactant production. Following optimization, biosurfactants will be extracted and purified. Purified biosurfactant will be structurally analyzed using thin layer chromatography, infrared spectroscopy, and nuclear magnetic resonance.

P42 - Construction of high-copy hemC::lacZ and hemE::lacZ reporters to identify a heme-responsive transcriptional regulator.

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The purpose of our research was to design and construct high-copy broad-host range *hemC::lacZ* and *hemE::lacZ* reporters based on the pBBR1-MCS5 backbone (Kovach, *et al,* 1995). This allows for expression of *lacZ* contingent on transcription of the *hemCE* promotors, permitting growth of *R. capsulatus* on lactose as a sole carbon source. Since the *R. capsulatus* genome lacks genes for the metabolism of lactose, we can therefore causally link expression of *hemC* or *hemE* to growth on lactose media. We have previously demonstrated that transcription of *hemC* and *hemE* is repressed by the addition of exogenous heme (Smart and Bauer, 2005). We propose the construction of a transposon library in strains of *R. capsulatus* that contain one of our reporter plasmids. Thus, any individuals that grow on lactose media in the presence of exogenous heme are demonstrating constitutive *hem* expression, signifying the disruption of the gene encoding the regulator responsible for heme-sensitive repression. The high-copy *hemC::lacZ* and *hemE::lacZ* reporters were constructed by insertion of the *Bam*HI - *Nco*I *lacZY* fragment from pNM482 (Minton, 1984) into similarly digested broad-host range plasmid pBBR1- MCS5 to construct pCM1. A linker containing several recognition sequences for a number of different restriction enzymes was inserted into pCM1 to improve the forward utility of this reporter plasmid (pCM2). A *hemCE* promoter fragment was generated by PCR and cloned into pCR2.1 TOPO (plasmid pJS309), then excised to orient the appropriate promoter upstream of, and in-frame with *lacZ* (plasmids pCM3 & 4).

P43 - The search for Vibrio cholerae genes involved in fatty acid-mediated biofilm formation

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Vibrio cholerae is a gram negative waterborne pathogen that causes approximately 3 million cases and 100,000 deaths worldwide each year (CDC 2018). Previous research has shown that *V. cholerae* responds to various fatty acids by altering behavior associated with virulence. Specifically, motility, biofilm formation, and antibiotic resistance were altered depending upon the fatty acid administered. The current study investigated the impact of three exogenous fatty acids on biofilm formation, an important survival, persistence, and pathogenicity trait of bacteria of medical importance. Using a *V. cholerae* transposon library, we selected 14 mutants implicated in playing a role in biofilm formation. Each mutant's growth characteristics and biofilm formation was assessed in the presence of 3 physiologically relevant fatty acids (linoleic acid [18:2], arachidonic acid [20:4], and docosahexaenoic acid [22:6]) in minimal media (CM9) at 37°C. Biofilm formation of the wild-type strain (C6706) of *V. cholerae* in CM9 was significantly decreased in the presence of 18:2 and significantly increased in the

presence of 20:4 and 22:6. While growth patterns among the mutants remained similar, there were notable differences in capacity for biofilm formation using a microtiter plate-based crystal violet assay. Six of the tested mutants exhibited the wild-type pattern of biofilm formation, suggesting that their respective gene products are not involved in the phenotype. The remaining eight mutants, representing various predicted sensory proteins, yielded altered biofilm profiles from wild-type when grown with 18:2. One of these mutants, lacking a functional methyl-accepting chemotaxis protein, was responsive to all three fatty acids. We are currently testing the temperature dependence (37°C vs. 30°C) of biofilm formation for all mutants. Our results have identified several gene candidates (encoding proteins that sense and respond to environmental conditions) involved in fatty acid-mediated control of biofilm formation in *V. cholerae*.

P44 - An Examination of Allee Effects in Vibrio cholerae

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A relatively recent phenomenon observed in organisms is called the Allee effect. This can be defined as population size-dependent behavioral change. These types of responses can be critical for bacteria with biphasic lifestyles, since adaptation to multi-conditional environments is paramount for survival and persistence. For example, *V. cholerae* experiences two major environments with distinct abiotic characteristics such as pH, temperature, and salinity. The current study examines the impact of inoculum size on key characteristics of *V. cholerae* under two physiologically relevant conditions (aquatic [30°C, 600mM NaCl, pH 8.1] and host [37°C, 150mM NaCl, pH 7.1] environments), including growth rate, biofilm formation, and motility. In general, dose-dependent responses for all three phenotypes were observed; however, bacterial growth, motility and biofilm formation were significantly influenced by their aquatic and host environments. For example, the same inoculum size exposed to host conditions leads to exponentially faster growth with higher overall bacterial yield than the respective ocean conditions. In fact, less than 10 CFU/ml supported growth in human conditions but not in ocean conditions during 40 hour incubation. Overall, the data contribute to defining *V. cholerae* fitness in the context of phenotypes associated with virulence. One potential application of the results is calculation of colony forming units per milliliter for predictive epidemiological modeling and environmental testing for risk assessment.

P45 - Biofilm formation and virulence factors of Candida albicans in JEG-3 cell line

Esther Choi, Madison Studstill

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A fungal commensal of humans, *Candida albicans,* has become increasingly problematic in delivery rooms and Neonatal Intensive Care Units in the United States. Congenital candidiasis is acquired in the uterus and causes chorioamnionitis, the appearance of nodules in the placenta and umbilical cord, and cutaneous infections after birth. The predisposing factors for neonatal candida infection would include low birth weight, use of antibiotics, catheter and parenteral nutrition. *C. albicans* infects humans predominantly in the biofilm phase, an organized cell communities attached to surfaces. Microorganisms in biofilms are enclosed in a matrix of extracellular polymeric substances. In the community, microorganisms efficiently adapt to stressful environments and exhibit increased resistance to conventional antibacterial and antifungal agents up to 1000 fold showing different gene expression profiles than their free-living counterpart. We aimed to determine important factors that influence biofilm formation and infection of *C. albicans* 9949 in JEG-3, a human placental cell line. We compared biofilm level of *C. albicans* at different chemical and physical condition to determine what genes are involved in biofilm. JEG-3 cells are to be infected with *C. albicans* and mutant strains of the genes that are important in biofilm formation. Changes in innate immunity such as NF-kB and mitogen-activated protein kinase response are under investigation in the cell line by qRT-PCR. Our findings would contribute to understanding in perinatal Candida diseases and can be utilized to prevent transmission of these diseases in hospital environments.

P46 - Isolation and Identification of Bacteriophage from Commercially Available *Bacillus thuringiensis*

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Bacillus thuringiensis (*Bt*) is a gram-positive, soil-based bacterium well-known for its insecticidal properties. When the bacteria undergo sporulation, they release toxic crystal proteins. Should those toxins be ingested by an insect larvae, the toxins bind to and denature the epithelial lining of the larvae's midgut. While the toxic crystal proteins are fatal for many types of insect larvae, they are safe for human consumption. Because of this, *Bt* is sold for use as a safe form of agricultural pest management. A widely available brand of *Bt* was purchased in order to discover more about the properties of *Bacillus thuringiensis*. When the product was streaked onto an agar plate and incubated, small plaques were visualized on the plates. Since bacteriophage would decrease the effectiveness of the marketed insecticidal properties of *Bt*, we questioned if bacteriophage had contaminated the insecticide. It was hypothesized that a new phage was isolated in this bottle of *Bt*. In order to determine whether or not the hypothesis was supported, it was imperative that the bacteriophage be purified. The concentration of the bacteriophage in the *Bt* was low, so the phage titer was amplified until the bacteriophage producing the plaques could be isolated and purified. Preliminary evidence indicates that we increased the phage titer and purified the phage DNA. Current experiments will include amplification of the TerS DNA region of the phage and then analysis to determine whether or not the hypothesis was supported and a new strain of *Bt*-specific bacteriophage was discovered. In addition, an electron microscopy of the phage will take place for further classification of the phage.

P47 - Efficacy Testing of Novel Anti-Biofilm Lead Compounds

Brian Tirado, David Goode, Linda Hensel

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The overuse of classical antibiotics has increased drug resistance in a broad range of prokaryotes. Biofilms, metabolically cooperative bacterial communities encased in an extracellular matrix, increase prokaryotic resistance to anti-microbial drugs. Consequently, biofilm-induced antibiotic resistance has become an increasing issue within the fields of medicine and agriculture. Broad spectrum antibiotics eradicate pathogens, but often result in the destruction of normal flora as well. Species-specific inhibitors of biofilm formation may become a promising addition to controlling bacterial invasiveness. The goal of this study was to synthesize a set of biofilm inhibitors and test their ability to reduce biofilm formation, while conserving cell viability. Over 300 compounds were synthesized via amide coupling synthesis between an amino and carboxylic acid. The compounds were tested with a crystal violet assay against three diverse species of bacteria: *Bacillus subtilis, Pseudomonas aeruginosa,* and *Staphylococcus aureus.* To ensure the screened compounds were specific to biofilm formation, the following assays were utilized to assess bactericidal/bacteriostatic activity: disk diffusion, use-dilution, and planktonic assays. Additionally, minimum inhibitory concentration and doubling time assays with and without synthesized drugs were used to characterize the compounds. Two of the ten phenylalanine derivatives specifically inhibited *B. subtilis* biofilm formation, and four of the 11 tyrosine derivatives specifically inhibited *S. aureus* biofilm formation. The closely related structures that have no activity will become useful when designing future potential lead compounds. Moving forward, students will utilize the established data base of potential biofilm inhibitors to design, synthesize, and test novel lead compounds while concurrently assessing an even wider range of bacteria. By creating compounds specific to biofilm formation rather than cell viability, we hope to design a set of drugs that are not only less harmful to the human body, but also alleviate the progression of antibiotic-resistant bacteria.

P48 - Assessing the Production of DNase A by Biofilm-Producing Environmental Competitors Induced by an Extract of *Pseudomonas aeruginosa* Biofilm.

Kyra Watral

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Bacteria are successional species in a mixed culture biofilm, and frequently the early colonizers such as *Pseudomonas aeruginosa* disappear from the community, as other microbes immigrate. *Pseudomonas* biofilm structurally requires extracellular DNA for much of the support. We

hypothesized that one method for eviction of the *Pseudomonas* spp. from the biofilm would be the inducible up-regulation of DNase A in successional bacteria.Extracellular DNA from a monoculture of *P. aeruginosa* biofilm was extracted via salting and centrifugation. The extract was diluted to 2 g of DNA per mL. 2 mL of extract was then infused into DNase test agar as the inducer. Environmental bacteria were isolated from Germania Springs Park creek in Jacksonville AL and screened on DNase test agar with and without the inducer. The relative amount of DNase produced was determined by the diameter of the zone of clearing. Although 3 of 10 isolates were identified as producing the enzyme, an increase in production due to inducibility was not detected. The hypothesis was rejected; the presence of *P. aeruginosa* extracellular DNA did not induce an up-regulation of DNase A to a statistically significant degree. Further testing will be performed using higher levels of inducer and with lab cultured DNase A-producing bacteria.

P49 - Antibiotic resistance awareness among undergraduate students

Valentina Roa

Miami Dade College - InterAmerican Campus, Miami, FL

Bacterial infections have plagued humans throughout history. In the past 70 years, antibiotics have changed the world by saving and improving countless lives. Now the world is facing the greatest threats to global health: Antibiotic Resistance. Antibiotics are crucial to treating infections but also to cancer and organ transplant patients, surgical procedures, pre-term babies, complicated deliveries to name a few. It is clear that understanding antibiotic resistance is critical. We conducted a public health awareness survey among the college students at InterAmerican Campus at Miami Dade College to learn about the general public knowledge and misconceptions on antibiotics. The data demonstrates that antibiotic resistance does not have the urgency it deserves on our campus. Antibiotic resistance should be taught and informed to college students to help limit antibiotic resistance development and the spread of antibiotic resistant bacteria.

P50 - The Bactericidal Properties of Bis-substituted Triazolium Salts

Julie Wilson, Lauren King, Kerri Shelton

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Cancer is the second-leading cause of death for all age cohorts within the United States, and the leading cause of death worldwide. As such, it has driven the exploration of a wide range of anti-cancer therapeutics within the past two decades. Many of these advancements have been crucial in extending the lives of cancer patients; however, the pharmaceuticals that are currently used can be toxic and may result in increased tolerance levels of the patient's cancer cells to treatment. In recent years, the continued challenge of combating cancer has caused a shift in research from traditional cytotoxic drug therapies to more targeted therapies aimed at increased selective cytotoxicity against tumor cell lines and decreased cytotoxic effects on non-cancerous cells within patients. This shift occurred in correlation with an increase in research on how to treat an already highly immunocompromised and suppressed population for nosocomial and secondary infections, primarily those caused by bacteria. In order to effectively combat cancer and the comorbidities associated with an immunosuppressed patient population, there is a distinct need for novel anti-tumor therapeutics that specifically demonstrate bactericidal properties alongside anti-tumor and anti-viral activity. In particular, novel anti-cancer therapeutics involving *N,N'*-bis-substituted triazolium salts have been developed, and have proven to be a unique therapeutic system that warrants further study to determine their biological properties as potential antimicrobial agents, particularly in gram-positive bacteria.

P51 - Comparison of Bacterial species richness in Organic vs. Conventional Farms

Ashley Sherrard, Cynthia Ryder, Elizabeth Danks

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In the current study, soil bacterial composition was compared in soils from two different methods of farming: organic and conventional. Generally, organic farming limits the use of chemicals and conventional farming uses more chemical fertilizers and pesticides. The use of chemicals in a conventional farm also allows food to be transported without spoilage during the process. The environmental conditions that are improved through organic farming include air and water quality, by

not using the chemicals that conventional farmers use, and a decrease in climate change by increasing the return of carbon to the soil. The soil contains various living organisms, including fungi and bacteria, which influence the soil's fertility and plant growth. The purpose of this study was to identify a difference in the soil bacterial richness in organic vegetable farms compared to conventional vegetable farms in the Bluegrass Region of Kentucky. Results showed that both types of farms shared some of the same bacteria but there was more species richness in conventional farms than in organic. The common species of bacteria found in both organic and conventional vegetable farms were *Lactobacillus plantraum, Lactobacillus delbrueckii*, *Citrobacter freundii*, and *Klebsiella pneumoniae*. These bacteria function together for plant growth and soil fertility by changing the nutrients in the soil as well as using root exudation, which regulates the rhizosphere interaction allowing for a regulation in the microbial community.

P52 - Scraping the Surface: The Isolation, Identification, and Analysis of Antibiotic Producing Bacteria from Williams Bayou, Palmetto, Florida

Julia Schran, Eric Warrick

State College of Florida, Bradenton, FL

One of the world's current and most concerning issues is the increase in antibiotic resistant infections following a 30 year decrease in new antibiotic development from pharmaceutical companies. According to the World Health Organization, the misuse of prescribing and taking antibiotics has led to this dangerous resistance and the creation of superbugs that is has put global health at risk. Tiny Earth is a program that is addressing the issue by involving students internationally to go out in the community and collect soil samples to test for possible antimicrobial agents that work against harmful microorganisms. This research used soil taken from a salt flat along the edge of Williams Bayou in Palmetto, Florida. After dilution and isolation, four different colonies proved to be interesting as they produced a zone of inhibition when put on solid medium containing *Staphylococcus epidermidis* and *Bacillus subtilis*. This poster will characterize these four microbes by *16s rRNA* analysis, chemical extraction of the antimicrobial compound, and phenotypic observation.

P53 - A Walk in the Park: The Isolation of Antibiotic Producing Streptomyces

Morgan Dettmer, Eric Warrick

State College of Florida, Bradenton, FL

Antibiotic resistance is an increasing threat to public health across the globe as bacteria adapt and become less responsive to treatment. Since major pharmaceutical companies are no longer focusing on the development of new antibiotics, the Tiny Earth research course guides undergraduate students from across the globe to isolate antibiotic producing bacteria from their local environments. In Bradenton, Florida, which lies on the Gulf Coast of Mexico, bacteria were collected from the soil and tested against Gram-positive and Gram-negative bacteria. One of the isolates showed antimicrobial activity against *Staphylococcus epidermis* as evidenced by a clearing zone. DNA was extracted, and then the *16S rRNA* gene was amplified through a polymerase chain reaction. The antimicrobial compound was dried, resuspended in the mid-polar solvent, ethyl acetate, and again tested for antimicrobial activity. With the DNA amplification, nucleotide sequencing was able to be performed. The National Institute of Health BLAST search returned the sequence as a 90% match to the *Pseudomonas* genus. The future of the project includes chemical structure analysis to determine the antibiotic(s), more testing against other Gram-positive and Gram-negative bacteria, and further DNA analysis with the goal of identifying the species of *Streptomyces*.

P54 - Going to the Beach for A Solution: The Isolation and Extraction of Compound(s) from the Exiguobacterium species.

Magnolia Valdez, Eric Warrick

State College of Florida, Bradenton, FL

With antibiotic resistance becoming prevalent, the search for a new microorganism with antimicrobial properties is imperative in order to avoid a world health crisis. According to the CDC, "Each year in the U.S., at least 2 million people are infected with antibiotic-resistant bacteria, and at least 23,000 people die as a result." The over prescription of antibiotics has aided in the development of resistant strains of pathogenic bacterium. As a part of the Tiny Earth Initiative, soil samples were collected

from Indian Beach in Sarasota, FL. to test for antimicrobial properties. Bacterial isolates from the soil were then tested against Gram-positive *Staphylococcus epiderimidis* and Gram-negative *Enterobacter aerogenes*. Using the organic solvent ethyl acetate, I was able to extract compound(s) in solution from an isolate that produced a wide zone of inhibition against *S. epiderimidis*. PCR was used to determine the genus of the bacteria of the unknown antibiotic producing bacteria. I used the following primer set, 63F/1387R, for the *16s rRNA gene*. DNA sequencing determined that the organism is of the genus *Exiguobacterium sp*. This poster will focus on the elucidation of antimicrobial compound(s) that inhibit the growth *S. epiderimidis*.

P55 - Isolating Antibiotics from Marine Soil for the Tiny Earth Initiative

Oliva Short, Eric Warrick

State College of Florida, Bradenton, FL

The Tiny Earth network empowers students to combat a global antibiotic resistance crisis by employing discovery-based research opportunities in college laboratory courses. In the search for new antibiotics, bacteria were isolated from Sarasota Bay and prioritized into 48 distinct cultures. These cultures were tested for antibiotic production against two SAFE-relative pathogens, *Bacillus subtilis* and *Pseudomonas putida*. Four cultures exhibited zones of inhibition in response to the pathogens and were selected for a chemical extraction test utilizing ethyl acetate. Pour plate analysis of the antibiotic extract did not reveal zones of inhibition in the presence of the two SAFE-relative pathogens, indicating the method of chemical extraction was not successful for any of the four selected cultures. Further testing should include multiple chemical extraction tests with solvents of differing polarities to increase the likelihood that antibiotic components with varied solubilities can be isolated.

P56 - Antibiotics as Modern Biological Weapons: A biological arms race between bacterial resistance and discovery.

Aubrey Carey, Eric Warrick

State College of Florida, Bradenton, FL

Antibiotic resistance has become a prevalent problem in recent decades, as fatalities from previously preventable infections rise. If no significant action is taken by 2050, multidrug resistant bacteria will result in more deaths than cancer and diabetes combined. While it is not a matter of "if" bacteria will become resistant to new antibiotics, but "when", we hope to prepare ourselves for the next lethal strain of resistance. Following protocols outlined by the Tiny Earth Initiative, bacteria were isolated from the marine environment surrounding Tampa Bay and tested for antimicrobial activity against Gram-positive and Gram-negative safe relatives of the ESKAPE pathogens. Isolates showed antimicrobial activity against *Staphylococcus epidermidis* and *Bacillus subtilis*. By sequencing the *16S rRNA* gene, isolates were identified as members from the following genera: *Algoriphagus, Erythrobacter, Mangrovibacter, Microbulbifer, Paracoccus,* and *Streptomyces*. Techniques of isolation, characterization of microbes, and antimicrobial activity will be discussed in this poster.

P57 - Characterizing gut microbiota in Plethodon cinereus, the Red-backed Salamander

N. Reed Alexander[1], Jessica A. Wooten[1], Donald M. Walker[2]

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Microbes are among the most diverse species on earth and have a wide range of metabolic abilities. Microbes are known symbionts of many multicellular hosts and have been shown to contribute to host evolution, ecology, immunity, and metabolism. Given a salamander's food preference, they are likely to harbor gut microbes that metabolize macromolecules. We isolated culturable gut microbes from seven *Plethodon cinereus* and created a metabolic profile for 222 pure cultures. In order to accomplish pure cultures, we collected salamander feces deposited on sterile filter paper moistened with sterile deionized water. We performed serial dilutions of the fecal pellets and plated it on LB agar. After 24-hours at 37°C, each unique colony was isolated into pure culture. Pure cultures were tested in triplicate on spirit blue to screen for lipid metabolism, on lab-made chitin agar for chitin metabolism, and on potato-agar plates for starch metabolism. Metabolic activity was determined if a zone of clearing was visible around the culture. In order to genotype the pure cultures, we used a direct colony PCR protocol for a subset of pure cultures, followed by amplification of a barcoding

gene (18S rDNA) to identify each isolate to, at least, the family level. Results of metabolic profiles were analyzed using discriminant function analysis in SPSS v. 25. There were eight possible metabolic profiles, but the pure cultures with no metabolism of lipids, chitin, and starch were disregarded from further analyses. The metabolic profile of the bacteria exhibited the ability to metabolize the following combinations in order of decreasing abundance: lipids and starch (n=79), lipids only (n=75), lipids, starch, and chitin (n=36), starch only (n=14), lipids and chitin (n=13), starch and chitin (n=3), and chitin only (n=2). Future research will investigate functional redundancy in the gut microbiome in this and other salamander species.

P58 - The Effect of Antimicrobial Peptide WAM-1 on Multi-drug Resistant *Acinetobacter baumannii*

Todd Wood, Lauren King

Columbus State University, Columbus, GA

Increasing multi-drug resistance (MDR) in *Acinetobacter baumannii* and other bacterial pathogens warrants research into alternative treatments. *A. baumannii* is of particular interest due to its prevalence as a nosocomial pathogen and high levels of antibiotic resistance. In this study, we characterized a collection of clinical isolates obtained from St. Francis Hospital in Columbus, GA. We determined the resistance or susceptibility to commonly-prescribed antibiotics as well as the ability of these strains to produce biofilms. We then examined the susceptibility of these clinical strains to the antimicrobial peptide (AMP) WAM-1. Several of the clinical isolates were MDR and produced significant amounts of biofilm. WAM-1 had potent bactericidal activity against these MDR strains and could offer a promising therapeutic alternative to currently available antibiotics.

P59 - Bacterial Communities in Salt Pans along the Mississippi Gulf Coast

Lauren Lawson, Eric Weingarten, Colin Jackson

University of Mississippi, University, MS

We sampled salt pans along the Mississippi Gulf Coast in order to find how the bacterial community might differ based on salt concentration. Samples were taken in July and October 2018, when the salt pans were dry and flooded, and from the surface and 30cm (I believe this is the number Eric said originally) deep in the sediment. DNA was extracted and the V4 region of the 16S rRNA gene sequenced (Illumina MiSeq) to determine the bacterial microbiome. Bacterial communities were compared between surface and deeper samples and flooded and dry samples. Samples taken from surface sediments had more bacterial sequences than those taken from deeper into sediment, and surface samples accounted for 73% of the 105,000 sequences in the dataset. Samples taken in July (dry conditions) yielded more bacterial sequences than those taken in October, when the site was flooded. Salt pan bacterial communities were primarily composed of members of the Proteobacteria, Bacteroidetes, Cyanobacteria, and Planctomycetes, although a total of 21 distinct bacterial phyla were detected. These phyla differed in their distributions, with members of the Bacteroidetes, Cyanobacteria, Plancomycetes, and Chloroflexi being manly associated with surface sediment, and Proteobacteria being more prevalent in deeper sediment. Proteobacteria, Bacteroidetes, Cyanobacteria, and Planctomycetes accounted for a greater proportion of the dry (July) bacterial community, whereas members of the Actinobacteria were more prevalent in the flooded (October) samples. In conclusion, salt pans along the Mississippi Gulf Coast harbor a diverse bacterial community that differs both spatially (by depth) and temporally (by season and/or flooded versus dry conditions). These environments can become hypersaline when dry, suggesting that this diverse community is adapted to both flooding and high salinity conditions.

P60 - Potential Cutaneous Physicochemical Changes and their Effect on Antibiosis in a Salamander Microbiome

J. Trey King, Richard M. Austin, Jr.

Piedmont College, Demorest, GA

Antibiosis, including antifungal metabolite production, by resident cutaneous bacteria of plethodontid salamanders is an important factor in plethodontid reproductive success. Factors such as habitat, age, and sex have been shown to influence the makeup of microfloral communities. However, recent studies indicate no significant differences between adult males and females in their cutaneous

microfloral communities. Notably lacking are data regarding the microflora of brooding females or their egg clutches. We sampled and phenotypically characterized the cutaneous bacterial flora of three attending female *Desmognathus ocoee* and their egg masses. Phenotypically distinct bacteria were tested for their ability to produce antibiotics effective in inhibiting bacterial growth in known Gram-positive and Gram-negative bacteria. Contrary to previous research, no bacterial isolate was found to possess the ability to produce antibiotics capable of inhibiting the growth of *Escherichia coli* and/or *Enterococcus faecalis*. Results concerning the cutaneous microfloral production of antifungal metabolites, as well as inferences regarding physicochemical changes to the skin environment and its concomitant effect on the cutaneous microflora, are discussed.

P61 - The effect of vulva wash on the growth of *Lactobacillus acidophilus*

Tahlaya Hudson, Jennifer Hancock

Mary Baldwin University, Staunton, VA

Lactobacillus acidophilus has multiple important roles in human health, including being part of the normal flora of the vagina. *Lactobacillus* species are lactic acid-producing bacteria that help to maintain the pH level in the vagina at a range of 3.5 to 4.0. This range is optimal for the growth of other normal vaginal bacteria and for the prevention of conditions such as bacterial vaginosis. Previous work has shown that feminine cleaning agents, such as douches and bubble baths, disrupt the microbiota of the vagina and can lead to bacterial vaginosis. This study will test the effects of three over the counter feminine vulva wash products on *L. acidophilus* growth. It is important to understand how products marketed for vulva use will affect the normal vaginal flora. Serial dilutions of the bacteria will be exposed to 4 different concentrations of the vulva washes and will then be grown in MRS broth. Control populations will also be grown from the same serial dilution in MRS broth. After 24 hours, the number of colonies will be counted on each plate. The numbers of colonies that grow from the exposed bacteria will be compared to the number of colonies that grow on the control plates. It is hypothesized that the vulva cleaning agents will decrease the growth of *L. acidophilus*.

P62 - Environmental and Life History Factors Influence Dragonfly Gut Microbiomes

Sarah Russell[1], Colin Jackson[2]

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Juvenile dragonflies (nymphs) may possess the ability to pass their microbiome to the adult life stage through metamorphosis. If this is so, the environment in which the nymph is reared may have an effect on the adult microbiome. In this study, dragonfly gut microbiomes were compared across life stage and when acquired from environments at varying levels of human disturbance. Nymph and adult dragonflies of 17 species were collected from North Mississippi and Memphis, Tennessee. The gut of each dragonfly was removed, DNA extracted, and a portion of the bacterial 16S rRNA gene amplified and sequenced using Illumina MiSeq. Bacterial communities were compared between nymphs and adults and between sample sites. Dragonfly species was identified through CO1 gene sequencing. Gut microbiomes of dragonflies primarily separated by site ($P<0.001$), which some influence from a site x life stage interaction ($P=0.01$). Species was also a significant variable ($P=0.02$) influencing the gut microbiome, and there were no significant interaction between species and life stage or site. Nymph and adult microbiomes differed in levels of dominant bacteria, with most adult microbiomes having Proteobacteria as their most abundant phylum. Nymph microbiomes showed a higher presence of Acidobacteria and Bacteroidetes ($P<0.05$), compared to adults, and also contained bacteria phyla that were not present in the adult microbiome.

P63 - Attachment, invasion, and surface protein expression of *Acinetobacter baumannii*

Rachel Pearson, Lauren King

Columbus State University, Columbus, GA

Acinetobacter baumannii is an opportunistic, gram-negative bacterial pathogen that causes many nosocomial infections in immunocompromised individuals. Increasing multidrug resistance (MDR) in *A. baumannii* warrants new approaches to understanding its virulence mechanisms and pathogenicity. As a first step in infection, *A. baumannii* has the ability to attach to host cells, providing a nutrient-rich environment for the bacteria to grow and perhaps facilitating biofilm formation and subsequent tissue invasion. In this study we characterized the biofilm formation, attachment,

invasion, and surface protein expression profiles of *A. baumannii* clinical isolates. Some isolates were resistant to commonly prescribed antibiotics, with five of the fifteen showing MDR. The majority of the isolates formed small amounts of biofilm, with two of the fifteen demonstrating high levels of biofilm production. All *A. baumannii* isolates were able to attach to human respiratory cells in vitro to variable degrees. Some isolates were able to invade human respiratory cells, independent of phagocytosis. All isolates expressed common surface proteins in varying amounts. This heterogeneity in biofilm formation, attachment, and invasion suggests that virulence mechanisms are strain-dependent, perhaps indicating that treatment of *A. baumannii* infections should be customized based on the location and type of infection. Future work is needed to elucidate the role of surface proteins in host cell attachment and invasion by *A. baumannii*.

P64 - Detection of Snake Fungal Disease Causing Fungus, Ophidiomyces ophiodiicola, on Free Ranging Snakes in Managed Habitats in Northwest Georgia

Jennifer Turner, Sara Grimm, Miranda Gulsby, Thomas McElroy

Kennesaw State University, Kennesaw, GA

Snake fungal disease (SFD), caused by the fungus Ophidiomyces ophiodiicola, is a potentially lethal fungal skin infection that is associated with localized declines of many snake populations in North America and abroad. Symptoms include open wounds, dermatitis lesions, scar tissue at the sight of infection, frequent shedding, and abnormal behavior; however, not all infected snakes exhibit symptoms. This disease was originally documented in rattlesnakes during 2006 and increased survey efforts since have found it in many other snake species. In Georgia, surveys for this disease have been performed heavily in southern portions, but minimal sampling efforts in the northern portion. The goal of this research is to fill the knowledge gap for the distribution of SFD in the state of Georgia. Our field team captured snakes using a variety of methods (drift fences, road cruising, and visual encounter surveys) in the Paulding and Sheffield Wildlife Management Areas located in northwest Georgia over a four-month period during 2018. The sampling efforts were restricted to the upland habitats of the management sites. Snakes caught using these methods were swabbed in the nasal pits, along the upper lip and a portion of the body using sterile swabs. For each snake swabbed, photographs and morphometric data were collected to document any skin lesions or characteristic symptoms of SFD. Snakes were released at their point of capture. We collected a total of 88 swabs from 11 different snake species during the sampling period. DNA extractions and qPCR laboratory experiments are being conducted to determine the presence of O. ophiodiicola from the swabs. We anticipate the results will estimate the prevalence of O. ophiodiicola in free-ranging snakes, variation in infection between species sampled, and add to the distributional knowledge of this disease in Georgia.

P65 - Sediment Bacterial Communities of South Atlantic Tidal Wetlands Driven by Salinity

Kayla Clark[1], Eric Weingarten[2], Colin Jackson[2]

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Sea level rise is projected to cause saltwater wetlands to migrate landward, replacing brackish and freshwater marshes. Few studies have examined how salinity impacts wetland bacterial communities despite their importance in nutrient processing. We sampled six Atlantic Coast wetlands (two freshwater, two brackish, and two saltwater), as a space-for-time substitution to predict how wetland salinization could impact the microbial communities of freshwater marshes. Five 30 cm-deep soil cores were taken from six wetlands on the coast of North Carolina and southern Virginia, USA. Bacterial DNA was extracted from the surface and bottom of each core, and Illumina MiSeq used to sequence the V4 region of the 16S rRNA gene. Ordination and analysis of similarity were used to compare the bacterial communities between the three wetland types. Bacterial community composition differed significantly between wetland sites (ANOSIM, $p < 0.001$). Across all samples, communities were dominated by Proteobacteria (31.3%), Chloroflexi (8.0%), Bacteroidetes (7.6%), Acidobacteria (5.7%), Planctomycetes (2.5%), Verrucomicrobia (2.2%), and Firmicutes (1.6%). Unclassified sequences were the most abundant members of the fresh and saltmarsh communities. Proteobacteria were the most abundant in the brackish marsh community. Ordination showed distinct clustering of samples by wetland type, with the microbiome of brackish samples being intermediate between fresh and saltmarsh samples. Saltmarsh bacterial communities were distinguished from the other wetlands by elevated proportions of sequences identified as members of the sulfate-reducing *Desulfobacteraceae*. Atlantic Coast wetlands differed in their sediment bacterial composition. These

differences in the sediment microbiome were driven by salinity. As saltwater moves inland as a consequence of sea level rise, sediment bacterial groups in fresh- and brackish-water wetlands will likely change, transitioning to an increased dominance of saltmarsh taxa.

P66 - *Rhus typhina* and *Rhus copallinum* extracts exhibit antimicrobial activity toward ESKAPE pathogens

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Antibiotic resistance is a leading contributor of the worsening public health crisis of the 21st century. Several medically-relevant bacteria are resistant to available antibiotics, especially the ESKAPE pathogens (*Enterococcus* sp., *Staphylococcus aureus, Klebsiella pneumoniae, Acinetobater baumannii, Pseudomonas aeruginosa,* and *Enterobacter* species). While very few new antibiotics are in development, discovery of novel antibiotic agents is imperative to combat this threat. Natural products represent a revived area of interest as a potential source for new antimicrobials. The National Center for Natural Products Research (NCNPR) has assembled a library of organic compounds derived from plants, fungi, marine, and algae species with potential antibacterial properties. Previous screening of the library identified *Rhus typhina* (stag's horn sumac) and *Rhus copallinum* (shining, winged, or dwarf sumac) as effective growth inhibitors of *P. aeruginosa*. To further test the *Rhus* compounds against other ESCAPE pathogens, both plants were harvested and ethanolic extracts of each were produced. Microtiter plates containing growth media were inoculated with ESKAPE pathogens. Approximately 40 mg of each compound was added to the appropriate well in the microtiter dish. After incubation at 37°C, bacterial growth was measured using a plate reader. Wells lacking treatment or containing antibiotics known to be effective at inhibiting ESKAPE pathogens were used to identify normal or inhibited growth levels respectively. Preliminary results indicated that both *Rhus typhina* and *Rhus copallinum* exhibited marked growth inhibition against the ESKAPE pathogens (5/6 and 6/6, respectively). Future investigations will involve the characterization and a detailed analysis of the antimicrobial efficacy of these compounds.

P67 - The Therapeutic Phage Discovery Laboratory at Wingate University: A continuing undergraduate research program.

Lauren Arrington, Olivia Brown, Samantha Hiller, Heather King, Shrevas Modi, Kaitlyn Monat, Meredith Saunders, Jonea Stewart, Christy Thompson, C. Brian Odom

Wingate University, Wingate, NC

Prior to the antibiotic revolution, bacteriophages lytic to pathogenic organisms were used to treat severe infections. For example, in 1931 silent and "talkie" film star Tom Mix was successfully treated with phage therapy for peritonitis resulting from a ruptured appendix. Interest in phage therapy has recently resurfaced as a possible response to combat, to some degree, the ever increasing problem of antibiotic resistance. Due to the specificity exhibited by phages for their hosts, large numbers of phage strains will be required for the effective reimplementation of this mode of therapy. Beginning in 2018, a undergraduate research program was implemented within the biology department at Wingate University whose purpose was to provide continuing research opportunities for undergraduate biology majors while also identifying and purifying bacteriophages from environmental samples that may show promise as antibacterial therapeutic agents. The advances made within this program, now beginning its second year will be discussed.

P68 - Exploratory investigations via 16S rRNA and rDNA Illumina sequencing into microbial community composition across a salinity gradient in coastal South Carolina wetlands

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Microbial community composition is an underlying driver of wetland biogeochemical processes. To better understand the biogeochemistry of long-term study plots in Winyah Bay, Georgetown, SC, we sampled surface and soil pore water (60 cm wells) at three sites - freshwater (<0.5 ppt), brackish water (~5 ppt), and saltwater (~32 ppt) for microbial community composition using 16S rRNA and

rDNA Illumina sequencing. We sampled the freshwater and brackish sites twice: December 2016 (flooded) and June 2017 (dry). We sampled the saltwater site during mid-tide in August 2017. Preliminary community analysis indicates differences among sites, season, and water source. We screened the results at class and genera level for characteristics and taxa that could guide future research. We found high relative abundance of Proteobacteria activity via rRNA analysis (potential locations for microbial fuel cell studies). Mercury methylation gene hgcA is known to be found in the bacterial genera *Syntophobotulus*, *Desulfovibrio*, *Geobacter*, and *Clostridium,*and these taxa were particularly active in the surface water of tidally influenced wetlands when compared to freshwater samples (up to 2% and 0.7% of microbial activity, respectively). Differences in potential halogenetic and dehalogentic activity were detected at all points on the salinity gradient, particularly in the saltwater plot where the relative abundance of taxa with halogenetic properties was the lowest, while relative abundance of taxa with dehalogentic properties was highest (0.7% and 6.1%, respectively). The methanogenic archaea genera *Methanobacteria* and*Methanomicrobia* were found across treatments with an rRNA relative abundance of methanotrophic *Thermoplasmata*(52%) that warrants further investigation.

P69 - The presence of *Clostridium difficile* spores in the environment of rooms in a Pediatric Intensive Care Unit

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Most hospital infection control programs for *Clostridium difficile* focus on patient-centric and hospital personnel-centric efforts rather than environment specific efforts. The environment of hospital rooms might contribute to Healthcare Associated Infections by this pathogen. This study seeks to quantify *C. difficile* spore contamination in the environment of a pediatric intensive care unit (PICU) of a children's hospital. Transport swabs were collected from five sites in three PICU rooms over a four-month period. The five sites were determined from previous surveillance in the PICU. Three sites were on the floor – 1 m from the door, immediately adjacent to the bed, immediately adjacent to the sink. One site was the patient's bed rail, and one the return air duct. These swabs were transported to a microbiology lab where they were used to inoculate Hardy Diagnostics C Diff Banana Broth, a selective and differential medium for *C. difficile*. The Banana broth tubes were incubated at 37 ºC and assessed for growth at 48 and 120 hours. Tubes positive for *C. difficile* were scored highly contaminated if positive at 48 hours, or moderately contaminated if positive at 120 hours (total swabs assessed = 90). Most contaminated sites in the rooms were the floor adjacent to the sink (46.7 % of swabs had *C. difficile* spores), the floor by the door (40%), and the floor adjacent to the bed (31.1%). The return air duct was positive on 26.6% of swabs. The least contaminated site was the patient's bed rails (2.2% positive). The intensity of spore contamination by site followed this same pattern. Overall, this data suggests that the floors in these rooms could serve as a reservoir for contamination of patients by *C. difficile*, particularly if the patient came in contact with items that touched the floor, or if spores were spread via dust.

P70 - Detection of Legionella Species in Various Potting Soils

Rayne Ragains

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Legionnaire's disease is a form of pneumonia correlated with high mortality and caused by bacteria of the Legionellaceae family, of which *Legionella pneumophila* Serogroup 1 is the most prominent. The primary source of transmission is through aerosolized water, however, there is a potential risk of infection from contaminated potting soil and composted material. Previous international research has found both *Legionella pneumophila* and *Legionella longbeachae* in potting soil, but to our knowledge comparable work has not been undertaken in the United States. In this study, commercial potting soil obtained from multiple brands, locations, and times will be examined for *Legionella*. Due to the advantages inherent in culture-independent and dependent detection, both will be utilized in this study. For culture-dependent detection, samples are evaluated using ISO 11731(2017) methodology, with appropriate measures taken to reduce competing microorganisms that hinder the detection of *Legionella*. With our culture-independent approach, we extract total DNA from the sample and make use of Quantitative PCR to detect the bacterium.

P71 - Identification of gram-negative bacteria in expressed milk: effects of storage on reuse

Casidy Stoltz, Cynthia Ryder, Kathryn Gill

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Breast feeding is the best source of nutrition and immunologic protection for infants. Since most mothers return to work six to twelve weeks post-partum, babies are left in child care or under supervision of family members. In this case, the mothers pre-express breast milk for the provider to feed the infant while in their care. In Kentucky, it is recommended that milk be discarded after one hour at room temperature. The purpose of this study is to compare the number and types of pathogenic bacteria present in warmed expressed breast milk immediately before and immediately after feeding, as well as 60 minutes after initial warming and after three hours of refrigeration and rewarming. The quantity and variety of pathogenic bacterial species were compared between sampling time points to determine if there was an effect of feeding and/or refrigeration on pathogenic bacterial presence in breast milk. Species identified included *Enterbacter aerogenes, Escherichia coli, Klebsiella pneumoniae, Shigellla flexneri*, and *Proteus mirabillis*. Almost all the gram-negative species identified are commensal bacteria, and are considered pathogenic in immune compromised hosts, if displaced, or in high quantities.

P72 - Experimenting with Non-Genetically Modified Organisms in Cornflakes Cereals

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The consumers' opinion on genetically modified (GM) foods is narrowly divided globally. According to Pew Research Center 2016 survey, approximately 49% of adults in the U.S. held negative views regarding GM crops, whereas only 5% viewed that GM foods are healthier than those grown without the help of genetic engineering. In 2018, per the study done by Statista Market Forecast in 2019, 286.44 million Americans reported that they consumed cold breakfast cereals daily. To determine if some of the more common cereal products were made with GM corn, we chose to test major-brand cereals. In this experiment, we are testing Kellogg's Cornflakes, Clover Valley Corn Flakes, Market Pantry Corn Flakes, Publix Cornflakes, Kroger Cornflakes, Nature's Path organic Fruit Juice Cornflakes, and Barbara's Bakery Organic Corn Flakes Cereal for the presence of Cry1A(b), Cry1Ac, and EPSPS genes, which are mostly found in GM corn. These genes originate from bacteria and their presence does not occur naturally in corn. Corn containing Cry1A(b) and Cry1Ac genes can produce its own pesticide which targets caterpillars and other pests, whereas the occurrence of EPSPS gene makes crops resistant to glyphosate, an inhibitor of shikimate pathway in all plants, and one of the most commonly used herbicides in farming. ZEIN3 & ZEIN4 will be used as primers to verify the presence of corn. We predict that if the corn that was used to make cornflakes is genetically modified, then the presence of the Cry toxin and EPSPS proteins will be detectable with both PCR and Elisa. As more cereals are being labeled as non-GMO verified, it may impact consumers' choice of what cereal to buy. This experiment was done to determine if the labeling of cornflakes is accurate, as there is a price increase associated with the non-GMO labeling.

P73 - Analysis of novelty seeking, multiple drug usage, and the serotonin transporter gene in college students

Shivani Vasudev, Jennell Talley, Matthew Schmolesky

Georgia Gwinnett College, Lawrenceville, GA

Drug usage affects users in multiple aspects of their life such as performance at school or jobs, in social settings, and their health. The purpose of this study was to analyze any correlations between use of multiple drugs and personality temperaments. Drug usage was based on the frequency of usage of six different drugs: opiates, illegal stimulants, cigarettes/e-cigs, club drugs, alcohol, and hallucinogenic drugs. One temperament defined by Robert Cloninger that may be related to drug use is Novelty Seeking (NS), which is the tendency to engage in adventure driven activities and make impulsive decisions. We collected survey data and DNA from student participants (n=226). 36% of the participants never tried drugs while 64% tried at least one drug. Participants that used more types of drugs had higher NS scores ($r=0.13$, $p=0.05$). Additionally, frequency of drug use and perceived risk

resulted in a significant negative correlation (r=-0.18, p=0.007). Participants who engaged in multiple types of drugs perceived drug use as a low risk (r=-0.13, p=0.056). A one-way ANOVA suggest students who identify as Biracial/Multiracial and White or Caucasian participants engage more frequently in drug use. Biracial/Multiracial students were more likely to perceive drug use as a low risk activity. Ongoing research involves investigating the relationships between this temperament, multiple drug use, and the polymorphisms in the of the serotonin transporter gene (SLC6A4) as well as performing additional analysis on participants who frequently use multiple drugs.

P74 - Directed Evolution of cold active Beta-galactosidases from *Geobacillus sterothermophilus*

Cynthia Obilor

Claflin University, Orangeburg, SC

In todays' world, millions of people cannot digest the sugar Lactose found in milk resulting in issues such as bloating and diarrhea; a condition known as Lactose Intolerance. Currently the main treatment for these individuals is use of "lactose free" milk which has had some of the lactose removed via the addition of a mesophilic beta-galactosidase from *Aspergillus oryzae*. This enzyme, which operates between 35˚-65˚C functions only during this high temperature of flash pasteurization and leaves some lactose undigested. In this work, we detailed the Directed Evolution of a thermophilic beta-galactosidase (bgaB) from *Geobacillus sterothermophilus* towards increased activity at lower temperature so that it can ultimately function while stored at refrigerator temperatures (4 ˚C) yet remain stable through flash pasteurization. Using a Polymerase Chain Reaction made Error Prone with addition of Manganese a mutant library with approximately 6 base per changes per gene was created. This library was inserted into vectors and transformed into lacZ deficient JM109 *E. coli* bacteria and screened for low temperature activity at 37ºC with the chromogenic substrate X-5-bromo-4-chloro-3-indolyl-beta-D-galactopyranoside (X-GAL). About 2000 colonies were screened and three blue colonies were obtained as the cold active mutant. Protein Over expression of the cold active mutant in a pet vector transformed in a JM109 *E. coli* DE3strain competent cell in order to produce tons of protein. The thermal dependence of activity for the cold active mutant is characterized and a structural mechanism for its enhanced activity at lower temperatures is presented here.

P75 - Investigation of Genetic Modification in Labeled Non-GMO Soy-Based Baby Formulas

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The introduction of genetically modified organisms (GMO) in common foods is a growing global concern. Soy has been widely adapted in the American diet and serves as the base ingredient for many commonly used products. According to the USDA, 94% of soy used in America is genetically modified. Therefore if companies are producing Non-GMO soy based products, they are being produced from a small percentage of the American soy crop. Generally, GM soy is produced by the introduction of the CP4-EPSPS gene to confer herbicide tolerance properties in the modified soy. Our research focuses on investigating the presence of GM soy in non-GMO labeled baby formulas. Our current data suggests we can extract and obtain amplifiable DNA (260/280 reading: 1.7 - 2.0) from lyophilized baby formula. Using PCR and ELISA methods, our study investigates the presence of the EPSPS4 gene and RR protein in baby formula samples (Gerber Good Start 1, Enfamil ProSobee, Parent's Choice, Baby's Only, Earth's Best, Organic PediaSmart, and Gerber Soy 3). Based on our current data there was no evidence of genetic modification in any Non-GMO labelled baby formulas. However, in instances where formulas were unlabeled, samples were positive for the presence of CP4-EPSPS, which highly suggest genetic modification. Based on a survey conducted on the Georgia Gwinnett College campus, 59.4% of the 256 survey participants do not trust Non-GMO labels. The findings of the study may help to restore the general population's trust in the labeling practices of Non-GMO product producing manufacturers.

P77 - Determining the Nativity of a *Typha latifolia* Population in a Mountain Bog via Genetic Analysis

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Typha is a genus of aquatic wetland flowering plants, including some widely distributed native and introduced species. *Typha* can have a strong ecological impact, and often dominates in wetland ecosystems due to significant asexual reproduction. The Tater Hill Plant Preserve, Watauga County, North Carolina, contains several wetland bog habitats. One small isolated bog contains a large population of *Typha latifolia* of unknown origin. This research will analyze the genetic diversity found in this population to investigate whether the population in the bog is native or introduced. We predict either robust genetic diversity, which would suggest a natural population, or a lack of genetic diversity typically associated with the founder effect if the population was introduced relatively recently. Tissue samples were taken from 30 individuals and DNA was extracted via the CTAB method. A set of microsatellite markers will be used to assess the genetic diversity. Knowledge of the nativity of *Typha latifolia* in the preserve will give us a more complete understanding of how these mountain wetland ecosystems function, as well as informing future land management decisions.

P78 - Testing Utility of Current Phylogenetic Markers in Genus Neohelix (Gastropoda: Polygyridae)

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As a significant source of calcium carbonate for wildlife and a major native detritivore that decomposes understory litter, land snails have a strong impact on our local ecosystem. Native land snails of the Appalachians have been highly understudied compared to other regional mollusks. A better phylogenetic understanding of this group would contribute to our taxonomic and ecological understanding of Appalachian land snails. This project aims to test currently available phylogenetic markers for applicability within Genus *Neohelix*. A group of six genetic loci from past studies on snails were PCR amplified with published primers and conditions to assess their utility for identifying polymorphisms. These markers include cytochrome oxidase I (COI) or a partial cytochrome oxidase I, cytochrome b (Cytb), large ribosomal subunits 16S and 28S, small ribosomal subunit 12S, and histone 3. DNA sequence alignments and an analysis of polymorphism from a small subset of individuals are presented with suggestions for marker use in phylogenetic studies of land snails.

P79 - The development of microsatellite markers for the culturally and economically significant plant, *Allium tricoccum*

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Allium tricoccum Ait. is an herbaceous monocot in the Amaryllidaceae family and is most commonly known as a ramp or wild onion. Ramps are traditionally used in Native American and Appalachian cultures, but their rich history and unique garlicy taste have gained the attention of the general public over the past fifteen years. Although not a rare plant, its growing popularity has led to over-harvesting and population declines. As a result of local population declines, the Great Smoky Mountain National Park (GSMNP) banned harvesting within its boundaries in 2002. This ban was reinforced by a study by Rock and colleagues that concluded that a ten percent harvest of a ramp-clump every ten years is the maximum sustainable harvesting intensity. However, no recent work has been done to understand the genetic variation or population structure of *Allium tricoccum* in the park since the ban. The purpose of this project is to develop microsatellite markers for *Allium tricoccum*. To date, we have generated Illumina data for the species and used MSAT Commander to identify potential hypervariable loci. This work will provide the tools necessary for population genetic studies of *Allium tricoccum* and will help inform conservation management decisions. Additionally, this project will screen for cross-species amplification of the markers in the narrow-leaved wild leek, *Allium burdickii*, and the nodding onion, *Allium cernuum*.

P80 - Comparative transcriptomics in higher order floral structures of Asteraceae

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Compositae (Asteraceae) is one of the largest and most evolutionarily and ecologically widespread flowering plant family. A major driver of success in this group was the evolution of the capitulum (a condensed inflorescence that mimics a single flower). The capitulum, or composite flower head, is considered a key innovation in the family. In about 70 genera in the family, multiple heads are aggregated into a higher order functional unit, the secondary head or syncephalium, that in many cases also mimics a single flower. The secondary head structure has been hypothesized to affect pollinator preference, provide protection against environmental conditions and herbivory, and has been shown to play a role in species and habitat diversification. Although it is known that this trait arose several times across the family, and some of their ontogenetic aspects have been anatomically studied, little is known about the genetics underlying this trait. For example, we do not know if the sets of genes involved in the formation of the secondary heads are the same involved in simple capitula or if there have been parallel genetic changes in diverse lineages where the trait evolved. As a first step toward understanding the genetic mechanisms involved in secondary heads, we conducted a comparative transcriptomic experiment in two closely related taxa in the Vernonieae—one with simple heads, *Centrapalus pauciflorus,* and one with secondary heads, *Elephantopus tomentosus*. We used next-generation sequencing to obtain transcripts of four different tissues involved in flowering (flowers, primary and secondary bracts and pedicel) and used leaf tissue as control. The samples were collected from specimens in cultivation under the same conditions at the same developmental stage and each tissue was sequenced in triplicate for each species. Bioinformatic analyses were used to investigate the genes and differential gene expression involved in each type of inflorescence.

P81 - Analyzing the Evolutionary Relationships of Rosa varieties by DNA Barcoding and RAPD

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The lineage of the genus *Rosa* can be traced mostly to Asia with some species originating in North America, Europe, and Northern Africa. Rosarians across the world have crossed and hybridized from their original form, called antiques, into their multiply-double modern variants. Though some rose lineages were thoroughbred, open-air pollination has led to the discovery of unintended and commercially viable species. Often with open-air fertilization the mother is known, while the pollinator is not. Various antique roses are so similar they could be considered the same species but are referred to by different names by their respective breeders. There is ambiguity over the exact number of *Rosa* species because of this. This study looked to understand the phylogenetic relatedness of 25 different varieties of roses currently found in North America. DNA barcoding and RAPD were used to determine their genetic relatedness. The two genes used for barcoding were the highly conserved *rbcL* gene, which codes for ribulose-1,5-bisphosphate carboxylase (RUBISCO) synthesis, and *matK*, which codes for a plant plastidial gene whose protein function is to splice out introns. PCR-amplified *rbcL* and *matK* gene fragments were sequenced and compiled with bioinformatics software for comparison between species with perceived relatedness. A combination of the DNA barcoding and RAPD techniques were used to generate a phylogenetic tree and a better understanding of the 25 varieties, which will be discussed.

P82 - Sequencing of the Fragmented Chloroplast and Mitochondrial Genomes of Pithophora sp. (Horsehair Algae)

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*Pithophora*is is a filamentous green alga within the order Cladophorales that can be found growing on the bottom or on the surface of ponds or other slow-moving water sources that are rich in nitrogen and phosphorus in very dense mats. *Pithophora*mats are a nuisance occurring as a result of eutrophication and are difficult to prevent and control. Genera within the order Cladophorales appear

to have unusual chloroplast genomic conformations where the genes do not connect to make a single circular chromosome. Instead they occur on linear fragmented pieces of DNA, usually without another gene. These fragments can fold into secondary structures but it is unknown if they associate into a single chromosome or remain as linear fragments throughout the life of the algal cell. In this study, an isolate of *Pithophora*was collected in central Georgia and cultured to be used to further explore the sequence, conformation, and, eventually, the expression of chloroplast genomes from this order. Total DNA was isolated and deep sequenced using Illumina's MiSeq technology. Using sequences from other Cladophorales genera as templates for assembly, twelve complete coding regions have been assembled from the chloroplast (*atpA, atpB, atpH, petA, petB, psaA, psaB, psbB, psbC, psbD, psbN*, and *rbcL*) and one from the mitochondria (*coxI*). So far all the assemblies have followed the pattern seen in other genera from Cladophorales, i.e. the genes occur on non-overlapping fragments and a single full-length coding region occurs on each fragment. Also of interest are the presence of non-canonical codons. Phylogenetic analysis of the sequences demonstrate that the coding regions are consistent with the genus *Pithophora*but the species cannot be confirmed. These data represent the first steps to a better understanding of how these fragments are maintained and expressed.

P83 - Chloroplast and Mitochondrial Genomes of a *Pediastrum duplex* Isolate from Central Georgia

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*Pediastrum*is a freshwater colonial green alga in the family Hydrodictyaceae, a family with poorly defined phylogenetic relationships. A *Pediastrum*sp. was isolated from a freshwater system in central Georgia and cultured. The purpose of this project was to sequence chloroplast and mitochondrial genomes of this isolate to 1 – phylogenetically identify the isolate to the lowest possible taxonomic level, 2 – provide new sequences to improve resolution within the Hydrodictyaceae family, and 3 – potentially provide genomic sequences to explore gene expression in this genus. Total DNA was deep sequenced using Illumina MiSeq technology and the chloroplast and mitochondrial genomes assembled with de novo assembly strategies using the software program Geneious. The chloroplast genome was circular and found to be nearly identical to an archived *P. duplex* culture isolated from Eastern Europe in the 1960s (UTEX LB1364). Only fragments of the Eastern European isolate have been sequenced and archived in GenBank so the data produced by this project completes this chromosome and provides evidence of a large inverted region which differs from two other archived *P. duplex*chloroplast genomes. The mitochondrial gene sequences are also similar to fragments from the UTEX LB1364 strain. The mitochondrial genome assembled in two different conformations, suggesting rearrangements have occurred and been maintained within this strain. Two other*P. duplex*chondriomes have been completed and archived and demonstrate a large number of inter-strain rearrangements. The mitochondrial genome produced by this project provides evidence that rearrangements may occur and be maintained within a single strain.

P84 - Microsatellite Primer Development for the Federally Threatened Apios Priceana (Fabaceae)

Annie Lindsey, Joshua Kraft, Lydia Deason, Robert Howard, Carol Baskauf

Austin Peay State University, Clarksville, TN

Apios priceana is a federally threatened species found in only four southeastern states (Alabama, Kentucky, Mississippi, and Tennessee). The conservation and management of a rare species is aided by understanding the species' population genetic structure and genetic diversity levels. Comparison with a widespread congener can also be informative, and *A. americana* is a congener which occurs throughout eastern North America. Here we identify some microsatellite primers developed for a future *A. priceana* population genetics study, including those that might transfer to *A. americana* in a comparative analysis. For the initial survey, 12-25 *A. priceana* individuals were assayed, representing 7-9 populations throughout the range of the species. Primer pairs were obtained from a library created by Illumina sequencing technology, with 23 of the 63 tested primer pairs amplifying under test conditions. Only nine were considered resolved after fragment analysis, yielding two monomorphic and seven polymorphic loci for *A. priceana*The number of alleles per polymorphic locus ranged from 2-9, with an average of 5.1 alleles per polymorphic locus. Heterozygotes were observed at five loci. At least one *A. americana* individual was included in all stages of the *A. priceana* primer survey, and

five *A. priceana* microsatellites also amplified for *A. americana* (one of which was monomorphic for *A. priceana)*. The two species shared an allele at one locus, but otherwise the alleles observed for *A. americana* differed from those of *A. priceana*. The resolved markers will be beneficial for future population genetics studies of *Apios*, and further primer optimization may allow us to increase the number of usable microsatellites. The levels of allelic polymorphism seen in the *A. priceana* populations are promising and may suggest that this rare species has relatively high levels of genetic diversity.

P85 - Algal Biodiversity Genetic Survey of the Middle Chattahoochee River

Amanda Hall, Kevin Burgess, John Hanson

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DNA barcode sequencing methods have been used to facilitate biodiversity studies by identifying species of flora and fauna all over the world. An area within biodiversity that is rarely investigated is algae. Algae plays a critical role in freshwater systems by indicating and affecting water quality. The amount and species of algae present can have negative impacts on drinking water facilities by causing the water to have taste and odor problems. The area of interest in this study is the middle Chattahoochee River, and DNA barcoding methods will be used to conduct a genetic biodiversity survey on this specific section of the river system. 1-liter water samples were collected from May – October in 2018 during the algal growth season from 5 sites in 5 reservoirs within the river system. The goal of this study is to uncover what species of algae are present in the middle Chattahoochee River.

P86 - Exploring the Repetitive Fraction of Grass Genomes using Galaxy

Patrick French, Matt C. Estep

Appalachian State University, Boone, NC

Poaceae, the diverse family commonly known as the grasses, contains some of the most economically important plants on Earth like maize (Zea mays), sugarcane (Saccharum officinarum) and sorghum (Sorghum bicolor). Complete sequenced genomes are available for maize, sorghum, and partially sequenced genomes are also available for sugarcane. The repetitive DNA elements that make up to 75% of these genomes have yet to be thoroughly studied. This project aims to explore and characterize the repetitive elements in six grass genomes that are closely related to the grass genomes that have been sequenced. With the ultimate goal of better understanding the mechanisms that have driven the diversification of this important clade. The platform Galaxy utilizes graph-based clustering to characterize repetitive sequences and homology search tools to detect transposable element protein coding domains. Using this tool, the distribution and characterization of repetitive sequences such as satellite repeats and transposable elements in the genome can be quantified. This has the potential for the discovery of novel transposable elements or other repetitive sequences. An improved understanding of repetitive elements across the grass phylogeny will provide better resolution to the grass clade and may uncover the mechanism behind the explosive evolutionary radiation of the grasses.

P87 - Human Genealogy and Computer Science: Interdisciplinary project in Bioinformatics

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Jacksonville State University, Jacksonville, AL

Genetic genealogy is a multimillion-dollar business that provides a scientific method for identifying possible genetic relatives using complex matching software and methods. Commercial testing agencies such as Ancestry, 23&Me, FamilyTree DNA, and MyHeritage, among others, test cheek scrapings and provide matches that a typical genealogist can use to confirm family history more accurately and to even identify matches that were unknown. One frustrating impediment for many researchers is the fact that chromosomal matches are provided and can be compared for overlapping homologous sequences, but only a few at a time. It is difficult to know which individuals should be compared without many hours of laborious comparisons. This research is an attempt to combine interdisciplinary activities between biology and computer science to develop a program which will allow rapid comparisons of matches by chromosome and overlapping regions. It clusters individuals with overlaps into groups which may indicate a shared genealogical background. A genealogist may

use this program to produce clusters of individuals of varying genetic distance into family groups quickly and easily. The result of this project is a Java application which can analyze a data file provided by one of the above-mentioned testing agencies. This application creates classes for genealogical matches, for people who have genetic overlaps with the test subject's DNA, and for chromosomes. An object is created for respective cases of each genetic match, chromosome, and person found in the data. For easy access, these objects are then used to store and organize any data the user might request. This allows a user to run the program, access a genealogical data file, and request a list of people who share a genetic overlap. With this information, the user can easily identify which individuals listed in the data file are most likely relatives.

P88 - Comparative Analysis of Four DNA Preparation Kits for *Quercus falcata*, *Quercus palustris, Quercus rubra* DNA Extractions and Subsequent DNA Sequencing

Devin Cummins, Timothy Trott

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Of the more than 8 million species suspected to populate the globe only 1.2 million had been catalogued. It has been estimated that it will take up to 1,200 years to process and catalog the remainder, meaning many species will go extinct before their discovery. (Mora et al., 2011). DNA barcoding may provide an solution to this problem. According to Hebert and Gregory, "DNA barcoding will accelerate the pace of species discovery by allowing taxonomists to rapidly sort specimens... highlighting divergent taxa that may represent new species… and by making species identifications more easily available" (2005). Barcoding has been used to chart the relationships between animals and plants, track endangered plant species, and update taxonomic classification (Schroeder et al., 2016; Simeone et al., 2013). Unfortunately, one of the essential steps for barcoding, DNA extraction, commonly yields genomic DNA containing contamination impairing downstream DNA utility, particularly interfering with DNA sequencing (Peist et al., 2001). In a recent study regarding DNA barcoding in *Quercus* species, the extracted DNA did not perform as expected in subsequent PCR or DNA sequencing (McKenzie and Trott 2017). Johnson theorized that polyphenol contamination was the likely cause of the malperformance. In this work, we have sought to troubleshoot problems found in Johnson and Trott's study. Using the same sample species (*Quercus falcata, palustris,* and *rubra* species), we are evaluating four commercially available plant specific DNA preparation mini-spin column kits to determine which produces the highest-quality PCR-gel electrophoresis results (intense single bands of the correct sequence length) and multiple, high-quality electropherograms (minimally overlapping signals and low indistinguishable nucleotide (N) instances). To date, certain kits have produced downstream PCR products of the expected size, but subsequent sequencing of these fragments has yielded poor DNA sequence runs. Ongoing troubleshooting is aimed at improving the quality of electropherograms.

P89 - Testing for reticulation events between three lineages of dusky salamanders in South Carolina

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Intuitively we expect that phylogenetic reconstructions should clarify discrepancies in the evolutionary history of dusky salamanders (*Desmognathus*). However, over time lineages may merge together in the region of contact zones. Moreover, it is also possible that hybridization between species can result in the formation of new species. Between the Blue Ridge Escarpment and the upper Piedmont of South Carolina three lineages of dusky salamanders (*Desmognathus*) come into contact. We have designated these lineages with the following placeholder names: *D. fuscus C*, *D.conanti A* and *D.conanti F*. All three lineages are very similar in appearance, which necessitates the use of molecular DNA sequence data to identify which lineage a population belongs to. This unexpected finding makes it essential to examine the contact zone between these recently recognized species/lineages to examine the nature of the genetic interactions in this area. Previously, research identified hybridization between the lineages of *conanti* and *fuscus*, therefore an investigative survey of the medium sized, streamside dwelling dusky salamanders is imperative. Here we present data collected using recently developed approaches to test for reticulation between these lineages. Integrating genomic and mitochondrial DNA sequence data in this reticulation framework should help clarify the taxonomic status of these salamanders.

P90 - Investigating the Presence of Genetically Modified Genes in Non-GMO Labeled Corn Chips

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Corn and corn based products are a significant part of the American diet, as seen in the 116% consumption growth since 1990. According to the USDA , currently 92% of the corn in the United States is genetically modified. In this study, the presence of herbicidal and insecticidal proteins will be analyzed in corn chips as an indication of genetic modification. Our study *will analyze six Non-GMO labeled samples (Late July Chips, Tostitos Simply Chips, PopCorners White Cheddar Chips, Simple Truth Organic White Corn Tortilla Chips, Garden of Eatin' Red Hot Blues Corn Tortilla Chips, and Simply Balanced Corn Tortilla Chips)*. The presence of Cry1Ab is a common indication of genetic modification in crops through the bacteria *Bacillus thuringiensis (bt*) to confer insecticidal properties in modified crops. The presence of the CP4-EPSPS gene indicative of the RoundUp Ready genetic modification for herbicidal resistance. *Our study* will also examine the samples to determine the presence of Zein gene (major gene in corn) , CP4-EPSPS, and Cry1Ab in the experimental subjects. Based on previous data, we fully expect all tested samples to display the presence of the Zein gene. However, the presence or absence of CP4-EPSPS and Cry1Ab will serve to prove or disprove the evidence of genetic modification in our Non-GMO labeled tested samples. This study will seek to mend the high level of distrust between food corporations and the public due to the high implementation of GMO and the lack of transparency in GMO labeling.

P91 - Determining seed viability and fruit maturation differences in weedy and native radish, *R. raphanistrum*

Cassie Stark

James Madison University, Harrisonburg, VA

Native radishes (*R. raphanistrum)* germinate in the fall and flower in the spring and can be found in the Mediterranean throughout Spain and France. In comparison, weedy radishes are agricultural pests that flower and reproduce in the time between tilling and harvesting and are thought to have evolved from native ancestors to compete with oats and other small grain species and can now be found on every continent except for Antarctica. The purpose of this study was to determine if radish seed maturation time differed between native and weedy radish varieties. Native and weedy radishes were grown and fruits were collected from three days (premature) to three weeks (mature). . Seeds were planted and germination success was recorded. Weedy radish fruits are predicted to mature faster and seed viability will be more successful at earlier collection dates compared to native radish as it develops faster due to it being a weed. Preliminary data suggests these predictions are correct, however results are not significant due to lack of time available for replication.

P92 - Comparing genetic diversity and resilience to human disturbance among Appalachian salamanders

Kaitlyn J. Loesel, Griffin D. Caracciolo, Jessica Smith, Daniel Whitson, Keelan Passmore, Andrew Duitsman, Julia M. Sandoval, Jessica A. Wooten, Carlos D. Camp, Emily Bewick

Piedmont College, Demorest, GA

Almost all organisms live in habitats that have been modified by human disturbances, and these disturbances can have extreme impacts on an organism's biodiversity. We measured these impacts on two Appalachian stream salamanders, *Desmognathus quadramaculatus* and *D. ocoee*. We collected samples from Nancytown Creek and Hazel Creek (two undisturbed populations in North Georgia) and from a stream system which had previously been disturbed by human development at Piedmont College. We analyzed genetic diversity and gene flow at the mitochondrial gene *COX1* (~ 600 bp). We found no significant genetic structure between Piedmont College and nearby Hazel Creek, indicating that human disturbances are not affecting gene flow between these two populations. Additionally, we found reduced gene flow between Hazel Creek and Piedmont populations with the Nancytown Creek population in a pattern consistent with isolation by distance. We compare our results to previous work in two other Appalachian brook salamanders: *Eurycea cirrigera* and *E. wilderae*. In contrast to *Desmognathus*, *Eurycea* from the Piedmont College population are less

genetically diverse and show high genetic structure with the other populations. These results likely reflect a reduction in genetic diversity and isolation of the population due to known human disturbances. We conclude that in this case *E. cirrigera* and *E. wilderae* are more severely impacted by human disturbances compared *D. quadramaculatus* and *D. ocoee*, which exhibit higher genetic resilience to habitat disruption.

P93 - Sexual selection and sexual-size dimorphism in lungless salamanders (Plethodontidae)

Tabea M. Soelter, Jessica A. Wooten, Carlos D. Camp

Piedmont College, Demorest, GA

Differences in body size between male and female ectotherms commonly follow a similar pattern of sexual size dimorphism (SSD) in which females are larger than their male counterparts. This is thought to be due to the females' role in egg production. However, males reach larger body sizes in certain species, including the salamander genus *Desmognathus*.This is the case even though members of this genus are phylogenetically nested within a group of salamanders that do not show this trend. A recent review of SSD in this genus and the larger family to which it belongs (Plethodontidae) offered a number of hypotheses to explain it, one of which is sexual selection. Intrasexual selection, especially male-to-male combat, can lead to males growing larger if size enhances competitive ability. Competition among males becomes more acute as the number of males increases relative to the number of available females. Therefore, we specifically tested the relationship between sex ratio and the size ratio between males and females in the subfamily (Plethodontidae) to which these salamanders belong using data from the literature. We first generated a fully resolved phylogeny using genetic data from GenBank. Then we used Spatial Evolutionary and Ecological Vicariance Analysis (SEEVA) to determine whether SSD is related to points of phylogenetic divergence. Next, we used phylogenetic generalized least-squares (PGLS) regression to determine whether sex ratio explains the pattern of SSD seen in *Desmognathus*. We found a significant correspondence between male/female size and the basal node for the tribe Desmognathini. We also found a strong relationship between male-biased maximum size and sex ratio with *Desmognathus* species having more males per available females than other members of the subfamily. Differences in life history, specifically differential ages at maturation, may explain the male-biased sex ratio in this genus.

P94 - Evidence of Horizontal Gene Transfer in the Kissing Bug Rhodnius Prolixus

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Horizontally transferred genes (HGTs) are a result of transferred genetic material across species and is not a result of direct descent. HGTs are common in prokaryotes but typically rare in multi-cellular eukaryotes however, rapid accumulation of genomic info has recently identified increased amounts of exogenous DNA inserts within insect genomes. The majority of the horizontally transferred material is non-functional however evidence shows some genes are being expressed and functional in some eukaryotes. In this study we used publically available sequence data and a newly designed bioinformatics pipeline to identify expressed HGTs in the genome of the kissing bug *Rhodnius prolixus*. We were particularly interested in identifying HGTs that were functional and associated with blood-feeding in arthropods. Therefore, our pipeline was designed to specifically target HGTs that are shared with other blood-feeding arthropods such as the bedbug *Cimex lectularis* and the mosquito *Aedes aegytpti*, but are absent in more closely related non-blood-feeding arthropods such as the pea aphid. We will discuss several of the candidate HGTs identified using this methodology in this poster.

P95 - Evidence of Horizontal Gene Transfer in the Pea Aphid Acyrthosiphon pisum

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The purpose of this study is to understand the role of horizontal gene transfer (HGT) in eukaryote evolution. HGT is known to be widespread in prokaryotes and allows for the rapid acquisition of traits

for mutation and gene duplication. HGT can explain how genes are independently transferred to multiple unrelated species. More recently, it has been foudn that HGT has allowed for the independent acquisition of traits in multiple distantly unrelated species in a variety of multicellular eukaryotes. In this study, HGTs will be studied to see if a gene is transferred among niche-sharing eukaryotic species. An ecological niche is a role a species has in its environment regarding how it survives, how it gains nutrition, and how it reproduces. A species' niche includes all of its interactions with biotic and abiotic factors in its environment. The study aims to discover if HGTs are shared by related niche-sharing species and absent from more closely related, but non-niche sharing species or if HGTs provide ecologically relevant traits to their host species. In this study we used a newly designed bioinformatic pipeline to identify shared HGTs in the genome of the pea aphid *Acyrthosiphon pisum* and other phloem feeding arthropods. This will test the prediction that shared HGTs are more likely to be found in distantly related, niche sharing species than in closely related, non-niche sharing species. This research will aid in discovering the unique relationship between in niche-sharing species and their genetic makeup.

P96 - New fossil material of the bowfin, Amia, from the Sentinel Butte Formation (Paleocene), Medora, North Dakota

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The species, *Amia calva*, is the only living member of the ancient family Amiidae. *Amia calva* is an icon in the field of comparative osteology, yet we have a poor understanding of the evolution of the genus because many fossil amiid bones have gone unidentified. Here we identify new material of the genus, *Amia*. Previously, the oldest known material identifiable as *Amia* cf. *A. pattersoni*, was a specimen from the Paleocene epoch of Alberta, Canada approximately 58 million years in age. Fossils of an unidentified species of *Amia* were found in the Sentinel Butte Formation, a geologic formation of Paleocene age (~ 60 million years ago) near the town of Medora, North Dakota. The specimens are classified as *Amia* because the coronoid tooth plates exhibit conical teeth and the parasphenoid exhibits a long tooth patch that extends anteriorly past the ascending rami of the bone. A sister taxon, *Cyclurus,* is also found in the same formation but has flattened coronoid teeth and a short, heart-shaped tooth patch on the parasphenoid. This new *Amia* material is distinguished from other species based on three criteria. First, the parasphenoid tooth patch is extremely wide posteriorly, reaching the lateral margins of the bone, but very long and narrow anteriorly. Second, the gular plate is uniquely shaped, not being truncated posteriorly but rather tapering both anteriorly and posteriorly. Third, the teeth of coronoid tooth plates are robust, unlike those of other species of *Amia* which are thinner and more elongated. These fossils represent a taxon that could attain a large size with a total length well in excess of 1 m and highlight the necessity to document other taxa to flesh out the evolutionary history of this long and important lineage.

P97 - Trees Infected with Mistletoe (*Viscum album*) in southwestern Arkansas

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Mistletoe (*Viscum album*) is a parasitic plant that infects a variety of trees and shrubs. Mistletoe attaches itself to its host tree by the haustorium, where water and nutrients are taken from the host tree. The number of mistletoe infections that a host can endure is likely to depend on host size, its proximity to fruiting conspecifics, and bird use. Birds can interact with mistletoe plants in three ways: they eat the berries that grow on the plants, they roost on the limbs, and they also use tree as nesting habitat. We hypothesize that infected trees could show a decline in condition when heavily parasitized, especially when numerous trees occur within close proximity that compete for shared resources. We selected 50 focal trees from 3 counties (Columbia, Lafayette, and Miller) in southwestern Arkansas to measure tree response variables (tree height, diameter, canopy cover, and leaf-out date). To census for competitor trees, we counted the number of other trees within a 10m diameter and documented the presence and absence of mistletoe on the five closest trees to the focal individual. Because mistletoe seeds are dispersed by avian consumers, we also performed bird observations on 10 of the 50 focal trees for 45-minutes each week for 6 weeks. We observed for consumptive interactions with mistletoe, perching locations on the trees, and flock characteristics

associated with tree use. We expected to find similarities in perching location and mistletoe height. This is important information to understand in order to predict the distribution of *V. album* in Arkansas. While our preliminary data suggest difference in local distribution (add numbers comparing county abundance), more research is needed to understand the interplay between mistletoe, its tree hosts, and its avian agents of dispersal.

P98 - Quantification of intelligible influences on the growth and distribution of American ginseng: Habitat modeling and field studies

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American ginseng (*Panax quinquefolius*), a well-known and sought-after medicinal plant native to North America, is facing increased threat of extinction due to overharvesting, herbivory, and habitat loss. The medicinal properties of ginseng allow natural, high-quality roots to command a price of several hundred dollars per pound in Chinese herbal markets—making it one of the most valuable herbaceous plants native to North America. As a result, many land-managers are interested in growing and harvesting ginseng to supplement their income, though they may not have a comprehensive understanding of what factors influence growth and survival. Habitat modeling is one tool that may be valuable to forest farmers or others interested in sustainably harvesting ginseng and other valuable forest herbs. We propose to refine a state-derived habitat model for ginseng by collecting additional presence-points and physiographical data in the Clinch watershed of southwestern Virginia—a hotspot for biodiversity containing productive mesic forests. We hypothesize that ginseng may be present in this region at aspects, elevations, slope inclinations, and soil conditions that the current model may not predict due to sampling deficiencies coupled with the unique physiography and regional microclimates. Finally, conserving and understanding ginseng in this region will enable easier and more sustainable harvesting in the future and could provide a boost to declining economies in regions where ginseng is most prevalent.

P99 - A Preliminary Analysis of Floral Morphological Traits Within a Population of *Hymenocallis coronaria* (Shoals Spider-Lily)

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The shoals spider-lily (Hymenocallis coronaria) is a macrophytic species endemic to the southeastern United States. The species is found only in the shoals of certain rivers and is greatly affected by anthropogenic disturbances. Understanding how phenotypic traits vary within a single population is key to understanding which traits are of importance for measuring phenotypic variation between populations. This study provides the basis for later comparison of phenotypic and genetic variation between two native populations found in different river basins. Floral character measurements were collected from 30 random individuals within a population located in Flat Shoals Creek (Harris County, Georgia). A Pearson Bivariate Correlation (using SPSS) was used to determine which measurements, if any, showed significant correlations with one another. PC-ORD was used to run Principal Component Analyses on morphological traits for individuals within the population. This information will be used for the morphological sampling of Flat Shoals Creek and the Flint River in spring of 2019.

P100 - Correlations between Seasonal Precipitation and Bobcat (*Lynx rufus*), Desert Cottontail (*Sylvilagus auduboni*), and Black-tailed Jack Rabbit (*Lepus californicus*) Photo Rates Over 9 Years in Southcentral New Mexico.

Rebecca Bolich, Travis Perry

Furman University, Greenville, SC

We used camera trap data from a large private ranch and weather data from the nearest weather station in southcentral New Mexico to evaluate the effects of precipitation in this semi-arid climate on bobcat (*Lynx rufus*) population trends. We used bobcat photo rates from a 100 sq Km remote camera grid as a proxy for relative population size. Bobcat photo-rates over a 9 year period were compared with seasonal and annual levels of precipitation with 0 to 3 year time lags. We found that spring

precipitation in the previous year was significantly correlated with bobcat population size in the following year (S=38, p-value=0.0503, rho=0.683). We suspect that this relationship between bobcat photo rates, assumed to be correlated with bobcat population size, and precipitation is mediated through the apparent population response of desert cottontails (*Sylvilagus auduboni*) and back-tailed jack-rabbit (*Lepus californicus*). Using the same type of data we found statistically significant positive correlations between precipitation and both cottontails and jack-rabbits in the same year (p=0.0176 and p=0.0559, respectively) and statistical significance or marginal significance with a 1 year time lag (p=0.044 and p=0.062, respectively).

P101 - A comparison of the enzyme profiles of two pitcher plant species (Sarracenia jonesii and *Sarracenia purpurea* var. *montana*) and their hybrids

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Although the effects of hybridization have been documented in various plant and animal systems, the consequences of this phenomenon in pitcher plants is not known. Two species of carnivorous pitcher plants (*Sarracenia purpurea* var. *montana* and the endangered *Sarracenia jonesii*) endemic to western North Carolina and northwestern South Carolina are known to hybridize in sympatry resulting in several small populations of hybrid progeny. These two species have very different ways of acquiring limiting nutrients (nitrogen and phosphorous), with *S. purpurea* var. *montana* relying on products from phytotelma communities within their pitchers, and *S. jonesii*. trapping and digesting prey. Hybrids of these two species are morphologically intermediate, but it is unclear which trophic strategy they employ. We sampled pitcher fluid from *S. purpurea* var. *montana*, *S. jonesii*, and their hybrids from two sites in western NC and used colorimetric protease and phosphatase assays to compare their enzyme profiles. We hypothesize that hybrids will have protease and phosphatase activity levels that are intermediate between the parental species. Our analyses will shed light on the potentially significant impact of hybridization on the fitness of hybrid pitcher plants.

P102 - Isotope Analysis of Breeding Tree Swallows (*Tachycineta bicolor*) in Western North Carolina

Zachary Lappie, Andrew Laughlin

University of North Carolina Asheville, Asheville, NC

Recent evidence indicates that tree swallows (*Tachycineta bicolor*) are expanding their range southwards. This is an unexpected pattern for these birds in light of climate change theory, which suggests most species will expand toward the poles. Isotope signatures vary across geographic regions, and have been used to differentiate between breeding populations. If this expansion is being driven from outside the breeding population, we expect to see differences in isotope signatures between returning birds and newly arrived birds. The null hypothesis is that returning birds and newly arrived birds will have similar isotope signatures, indicating that the newly arrived birds bred in the same area the previous year. To explore the drivers of this range expansion, we compared dD isotope values between returning and newly arrived individuals during the summers of 2017 and 2018. We took feather samples from a small population of breeding birds at Beaver Lake in Asheville, NC, with additional samples coming from returning birds and new arrivals from another breeding site in Boone, NC. Preliminary results from the Beaver Lake samples show a clear pattern differentiating isotope signatures of recaptured birds from others in the 2018 season, indicating that this expansion may be driven from outside the local breeding population. Additional results from the Boone population will be presented in the final poster.

P103 - Quantifying Nectar Rewards of Bee-Preferred Wildflower Species Native to the Southern Appalachian Mountains

Christian Brown, Jennifer Geib

Appalachian State University, Boone, NC

Nectar is an important limiting resource offered as a reward to pollinators by flowering plants. Optimal foraging theory predicts that a pollinator will strike a balance between energy spent foraging and net energy gathered from foraging. Therefore, understanding the amount of net energy gathered (nectar

constituting much of that energy) may help in explaining behaviors of pollinators, as well as the relationship between pollinator and plant. The aim of this project was to quantify energetic rewards from nectar in 5 species of bee-preferred wildflowers in the Southern Appalachians. Nectar was rinsed from flowers and collected in 2 mL micro-centrifuge tubes. Absorbance of samples was determined via spectrophotometry using anthrone indicator and comparison with sugar standards. Obtaining data for nectar concentrations will allow for this floral resource to be used in mathematical models. One such model is the "resources collected" model which predicts the amount of resources collected by a population in a given area. Our results indicated unsurprisingly that nectar sugar concentration varies among floral species, resulting in varied model output. Being able to compare nectar sugar concentration of different plant species may also allow for predictions to be made regarding the interactions between pollinator and plant.

P104 - Investigating Phenotypic Plasticity of Hydrocotyle bonariensis in Response to Soil Type and Salt Spray

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Phenotypic plasticity is defined as variation in the phenotype of a plant in response to variations in the environment. *Hydrocotyle bonariensis* is a broad-leaf herbaceous perennial common to both coastal sand dune and inland sites along Coastal Georgia, which vary considerably in environmental conditions. Previous research on phenotypic plasticity in *H. bonariensis* suggested differences in stomata morphology between sand dune individuals grown in sand dune soil and soil from an inland habitat. The aim of this study was to further investigate phenotypic plasticity in *H. bonariensis* by determining the influence of soil type and salt spray on leaf morphology and physiology for individuals from the sand dune habitat and an inland habitat. Specifically, *H. bonariensis* individuals were collected from Tybee Island (coastal sand dune habitat) and Georgia Southern University Armstrong Campus (inland habitat) and grown in either Tybee Island or GSU campus soil. Additionally, random individuals in each treatment received a salt-water solution weekly to mimic salt spray. Random leaves were selected in each treatment weekly for measurements of photosynthetic efficiency, after which leaves were collected for leaf morphological measurements and preparation of stomata peels. Images were taken of stomata peels at 10x using a compound microscope, and stomata density and size were estimated using Adobe Photoshop and ImageJ. Results from this study will determine if *H. bonariensis* shows phenotypic plasticity in leaf morphology or physiology in response to variations in soil type. Additionally, these results will elucidate if individuals in sand dune habitats possess unique adaptations to the abiotic factors common to coastal sand dune habitats.

P105 - Anthocyanin profiles of Photinia glabra during leaf expansion, senescence, and infection by the pathogenic fungus, *Entomosporium mespili*

Harrison Seitz, Nicole Hughes, Sarah Jessica Forte

High Point University, High Point, NC

Recent studies have demonstrated that different anthocyanin "fingerprints" are associated with different stresses in plants. To expand on this new area of research, we used microscopy and HPLC-MS to quantify and characterize anthocyanins in *Photinia glabra* leaves during three contrasting life stages: leaf expansion, infection by the pathogenic fungus *Entomosporium mespili* (which induces a red halo around the infection), and senescence in infected leaves; uninfected, fully-expanded green leaves were used for comparison, in addition to green tissues around the red halo of infected leaves. Red-pigmented tissues expanding and leaves featured the same five cyanidin-based anthocyanins, at similar concentrations. Senescing leaves contained four of these five anthocyanins (at ~25% concentration), while green tissues contained only very small amounts of either one (uninfected leaves) or two (infected leaves) of these anthocyanins. No acylated anthocyanins were detected. Cyanidin-3-galactoside comprised the greatest proportion (>75%) of the anthocyanin pool in all red tissues. Uninfected green leaves lacked this anthocyanin entirely, and only contained trace amounts of cyanidin-3-glucoside; in contrast, green areas of infected leaves contained 60:40 proportions of cyanidin-3-galactoside and cyanidin-3-glucoside. Interestingly, concentrations of cyanidin-3-glucoside were relatively constant in all leaves sampled, except in senescing leaves, where the pigment was absent. All cases of reddening corresponded with anthocyanins in palisade and spongy mesophyll tissue. From these results we conclude that: 1) anthocyanins synthesized in response to *E. mespili*

are the same as those in expanding leaves in this species, suggesting they perform a similar function and/or are induced by the same cues, 2) there is no specific anthocyanin fingerprint associated uniquely with *E. mespili* infection (although it is possible that anthocyanins in expanding leaves are synthesized in anticipation of infection), and 3) cyanidin-3-glucoside is retained during all life stages in leaves, but is degraded during senescence, for reasons unknown.

P106 - Anthocyanins increase flower temperature: a study using a broad range of taxa and flower morphologies

Sarah Jessica Forte, Nicole Hughes

High Point University, High Point, NC

Anthocyanin pigments absorb strongly in the green and UV-B wavebands, and several studies have demonstrated that pigmented flowers tend to be warmer than non-pigmented (white) flowers. However, most studies focus on a single species, comparing interior and/or corolla temperatures between differently-colored individuals. The objective of the current study was to quantify the effects of anthocyanin pigmentation on petal warming across a broad range of species representing diverse flower morphologies, and identify morphological factors that result in the greatest differences in temperature. The study took place in the Mariana Qubein Botanical Garden on the campus of High Point University in High Point, North Carolina, USA. Six taxa representing six plant families were examined, and flowers with low, medium, and high amounts of anthocyanin pigment (e.g. white, pink, and red) were compared. The effects of corolla size and color on temperature were measured using infrared imaging of excised flowers, which were inserted into a white cardboard sheet and oriented perpendicularly to the sun on a sunny day. Measurements were taken under both UV-exclusion and UV-inclusion films. Fine-wire copper-constantan thermocouples were also used to monitor temperature of attached flowers over time. Results showed a significant correlation between anthocyanin content and corolla temperature in all species examined. The greatest temperature differences between white and pigmented flowers occurred in large flowers with planar morphology, which minimized self-shading. A significant UV effect was only observed in one species (*Begonia x semperflorens-cultorum),* which may due to the presence of acylated anthocyanins. Next steps will include adding more species to the study, to expand the range of flower sizes and morphologies surveyed.

P107 - Physiological responses to LPS: immunity vs dispersal in Florida cane toads

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Invasive species on the expanding edge are predicted to have decreased immunity compared with conspecifics from more established ranges, specifically inflammatory responses that may be energetically costly and decrease dispersal. To determine if cane toads, a large invasive species introduced into Florida in the early 1930's that has spread northward through the state, near the invasion front in Florida have decreased immune responses, individuals were collected from a core and northern invasion edge population and given an immune challenge with lipopolysaccharide (LPS). Toads were injected with either saline (n = 5 and 6, core and edge, respectively) or 20 µg/gram of body mass with LPS (n = 11, 9 (core, edge, respectively)). Toads were bled at 2 and 20 hr, and metabolic rates, plasma corticosterone (CORT) levels, bacteria killing ability (BKA), neutrophil: lymphocyte ratios (N:L), and lactate levels were assessed. Metabolic rates of saline-injected toads from the core population decreased more rapidly with time throughout the 20 hr period compared to the edge population ($p = 0.03$), although rates of LPS-injected toads were not affected by location ($p = 0.32$). Lactate levels were not significantly affected by location or treatment ($p = 0.76$ and $p = 0.93$). There was a significant interaction between location and time on CORT ($p = 0.03$), and elevations of N:L ratios and BKA for cane toads responding to LPS from the two populations were differentially affected with time ($p = 0.03$ and $p = 0.006$ for N:L and BKA, respectively). These results suggest that although magnitude of immune responses may differ with these populations, timing of response may play a role in immunity among populations of this invasive species.

P108 - Impacts of Polyploidy on the Ecophysiology of *Solidago altissima*

Katie Krogmeier, Howard Neufeld

Appalachian State University, Boone, NC

The evolutionary and ecological importance of polyploidy in plants is still a subject of much research. Polyploidy could be an evolutionary dead end or it could lead to reproductive isolation and creation of new species. How polyploidy impacts plant ecophysiology and in turn responses to climate change are poorly understood and are the goals of this project. Goldenrod (*Solidago altissima*) is a North American flowering plant with diploid, tetraploid, and hexaploid populations: diploids occur in the midwest and hexaploids in both the midwest and east. We propose that the different geographic distributions of the polyploids result from natural selection for varying environmental conditions that arise from differences in morphology and ecophysiology. For example, polyploids have larger cells, which can affect stomatal densities, sizes, and kinetics, and ultimately gas exchange rates. We conducted gas exchange measurements on potted plants outdoors at the Appalachian State University greenhouse using the Li-6800. Measurements at saturating light were made in July and light response curves were made in September. Rates of photosynthesis were higher in July than September for all populations and highest for diploids compared to hexaploids, which did not differ (20.4 vs 16.6 μmol m^{-2} s^{-1}, p = 0.042). There were no population differences in stomatal conductance, transpiration or water use efficiency. In September, maximum photosynthetic rates were still lowest for eastern hexaploids, but midwest hexaploid rates remained elevated and were not distinguishable from diploids (12.8 vs 9.6 μmol m^{-2} s^{-1}, p = 0.031). The drop in photosynthetic rates in September may have resulted from leaf aging and/or rust infection, which became prominent late in the season, even though only uninfected leaves were measured for gas exchange. We are currently making SEM and light microscopy measurements on leaf cross sections to ascertain morphological differences in cell size and leaf structure between cytotypes.

P109 - Histological analysis reveals background levels of intersex in Largemouth bass (*Micropterus salmoides*) of the Chattahoochee River and two tributaries, Columbus, GA

Meenal Joshi[1], Elizabeth Klar[1], Abigail Abernathy[1], Amy Sibley[1], Jeramy Belt[2], Michael Newbrey[1]

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There are no published studies explicitly identifying the background levels of intersex in male Largemouth bass (*Micropterus salmoides*), and this lack of knowledge limits our ability to interpret the species-specific severity of intersex. We hypothesized the occurrence and prevalence of intersex should be the same in the Chattahoochee River and two of its tributaries. We collected Largemouth bass using backpack and boat electrofishing techniques from Lindsey and Heiferhorn creeks, and Lake Oliver of the Chattahoochee River. Gonads were collected and studied using histological techniques. Largemouth bass from Lake Oliver (n=18 males) exhibited intersex in 78% of the males. However, in Lindsey and Heiferhorn creeks (n=19 males), there were no oocytes present in the gonadal tissue; therefore, each of these creeks has a 0% level of intersex. Through this information, we have preliminarily concluded that the background levels of intersex in Largemouth bass is zero. Conversely, Lake Oliver, which is part of the Chattahoochee River, has a significant level of intersex with oocytes present in most of the males examined. This evaluation demonstrates that no intersex is possible in Largemouth bass and showcases the extremes in intersex among connected rivers within the same drainage.

P110 - The Role of Leaf Angle and Its Influence on Potential Gas Exchange in an Evergreen Holly

Erica Pauer, Fernando Alejo-Vann, Kathyrn Young, Anthony Percival, Liliana Rangel-Parra, Courtney Watts, Howard Neufeld

Appalachian State University, Boone, NC

The angle of display and azimuthal direction are major determinants of the incident radiation captured by a leaf. These factors can affect the timing and amount of photosynthesis that a leaf can perform, as well as alter transpiration rates through effects on leaf water relations and stomatal conductance. Few studies have characterized the variability in leaf angles for broad-leaved woody plants, in part because of the large number of leaves present. As part of an intensive investigation on the wintertime ecophysiology of an evergreen holly, *Ilex x 'Nellie R. Stevens'*, we measured the distribution of leaf

angles and azimuths on bushes growing adjacent to the Rankin Science building on the campus of Appalachian State University. Ten leaves/branch, for 5 branches/bush located at mid-canopy for 3 bushes were measured on both the north and south facing sides, for a total of 300 measurements. Leaves were grouped into angle and azimuthal classes for analysis. For the sun leaves, 58% were within 40° of horizontal and 61% faced south to west. In contrast, 77% of shade leaves were within 40° of horizontal but 85% faced north to east. Approximately 41% of sun leaves were oriented to within 45° of vertical compared to only 15% of shade leaves. Thus, overall, sun leaves are more vertically oriented and face toward the south and west whereas shade leaves are more horizontally oriented and face toward the north and east. These groupings will be used to calculate the total radiation incident on leaves over a season, using the NASA Solar Angle calculator and other programs that provide estimates of incident radiation on inclined surfaces. The results will show how different the gas exchange physiology can be for woody plants with leaves of widely varying orientation and should be useful in developing models of whole canopy gas exchange.

P111 - First Year Results on from Phenology Gardens and a Phenology Trail on the Campus of Appalachian State University

Morgan Ayers, Erica Pauer, Anthony Percival, Katie Krogmeier, Howard Neufeld

Appalachian State University, Boone, NC

As part of an NSF-funded grant, we established sun and shade phenology gardens, as well as a tree phenology trail, on the campus of Appalachian State University in Boone, NC. Similar gardens and trails were established at collaborating institutions Warren Wilson College and the University of North Carolina at Asheville. We set up Decagon weather stations in both gardens so we can relate weather to phenology. Native herbaceous species were planted in late fall of 2017 and early spring of 2018 in 1 m^2 plots, replicated 5 times in each site, with 3 individuals per plot. For the tree phenology trail, 10 species were selected so that the trail could be assessed in approximately 1-hour time, thus facilitating the routine measurement of phenological events. For each tree species, there were 5 replicate individuals of similar size located within proximity to each other, so as to avoid confounding due to habitat variation. We measured the timing of phenological attributes that included emergence from the soil, leafing out, bud swelling and break on trees, flowering, fruit set, and leaf and shoot senescence. Depending on activity rates, we measured either once or twice weekly from March to November. Data were downloaded to the National Phenology Network site. We report results of our first year of data, using graphics that show the extent and timing of each event. We also report on a variety of technical issues including dealing with insect outbreaks, weeds, and plant death. The results of this ongoing study will be compared to those for our collaborating institutions, which have the same species in the garden plots, and we will continue to build a baseline database so that future sets of students can compare their results with ours to determine the impacts of global climate changes in the southern Appalachian Mountains.

P112 - Morphological responses to diet by the generalist grasshopper *Melanoplus differentialis*

Jerry Howard, Austin Culotta

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Many organisms are known to display morphological plasticity in response to diet, and some insects display adaptive plasticity in head size in response to hard and soft diets. We asked how adaptive morphological plasticity contributes to the ability of a common generalist grasshopper species, *Melanoplus differentialis*, to exploit a wide variety of plant resources. We established a laboratory study population from grasshoppers collected in Sonoran Desert grasslands in southern Arizona. We measured head and body dimensions and biting performance of grasshoppers reared on hard and soft diets, and predicted that bite force and relative allocation to head capsule and biting structures would be greater in individuals reared on the hard diet than on the soft diet. Most measures of body dimensions were significantly larger in insects reared on the soft diet than on the hard diet, and most body dimensions were significantly larger in females than in males, but only head height showed a significant diet x sex interaction. Scaling relationships between body dimensions and mass were generally isometric and did not vary among diet treatments. Head height and body mass showed a significant positive relationship to bite force, but head height scaled with mass at a lower exponent than either wing length or femur length, indicating that investment in biting structures increased at a slower rate than investment in locomotory structrures. Although *M. differentialis* showed diet-induced

morphological plasticity, responses were more consistent with passive nutritional limitation on the hard diet than with adaptive allocation of resources to greater biting performance. We suggest that strong stabilizing selection on adult feeding morphology in the environment of the source population restricts the potential advantage of adaptive morphological plasticity in nymphal stages during development.

P113 - Winter Time Gas Exchange in an Evergreen Angiosperm: Intra-Canopy Differences and Responses to Light

Anthony Percival, Liliana Rangel-Parra, Erica Pauer, Kathyrn Young, Fernando Alejo-Vann, Courtney Watts, Howard Neufeld

Appalachian State University, Boone, NC

Research on winter season gas exchange has been conducted primarily on woody evergreen gymnosperms. As a result, we know less about whether evergreen woody angiosperms can maintain positive rates of photosynthesis while exposed to high light at or near below-freezing temperatures. These conditions can reduce photosynthesis because of damage primarily to PS II, a process known as photoinhibition. Holly (*Ilex* sp.) are common, broad-leaved evergreen trees and horticultural landscape plants, capable of forming very dense canopies. Previous research on European holly (*I. aquifolium)* showed a capability for positive photosynthesis during winter, but leaves exposed to the combination of high light and low temperatures suffered photoinhibition, which was quickly alleviated by imposition of higher temperatures and shading. During the morning when solar radiation is at a low angle, leaves on the sunny side of a canopy are exposed to high light, while those on the other side are heavily shaded. We are interested in whether the landscape shrub *Ilex* x 'Nellie R. Stevens' exhibits measurable gas exchange during the winter and whether diurnal variation exists in gas exchange as a result of canopy aspect. Using the LI-6800 and LI-6400XT gas exchange systems with clear top chambers we measured leaf responses at ambient winter conditions at 2 sec intervals for ~6-hour periods on sunlit and shaded sides of holly, as well as dark-adapted fluorescence. Under ambient conditions sunlit leaves had higher photosynthetic rates than shaded leaves (2.8 vs 1.1 μmol m^{-2} s^{-1}), due to much greater light levels (567 vs 32 μmol m^{-2} s^{-1}), even though they had lower Fv/Fm (0.319 vs .0.658, $p < .001$), indicative of photoinhibition. Further evidence for photoinhibition was found using light response curves, which showed slightly lower, albeit non-significant, rates of photosynthesis (3.1 vs 4.8 μmol m^{-2} s^{-1}, p=.123) in sunlit vs shaded leaves.

P114 - Occurrence of intersex in male Spotted bass, *Micropterus punctulatus*, Chattahoochee River, Columbus, Georgia

Cherish Jordan, Elizabeth Klar, Michael Newbrey

Columbus State University, Columbus, GA

Every day, millions of gallons of wastewater and pollution are released into the Chattahoochee River Basin with untold consequences. One possible repercussion is a phenomenon known as intersex. Intersex is the occurrence of oocytes in the testes of male fishes. The purpose of this study is threefold: evaluate if intersex is occurring in Spotted bass, Micropterus punctulatus, of the Chattahoochee River, determine the severity of intersex and finally, compare the severity of intersex to the age of fish. In order to conduct this study, the Lake Oliver reservoir was sampled by electrofishing boat over the course of one year. Fish were collected and dissected for gonads and otoliths. Gonads were preserved, sectioned and stained before observing microscopically for the presence of oocytes. Otoliths were used for estimation of chronological age. Forty-one Spotted bass were collected from Lake Oliver, and 25 of them were male with 40% of the individuals sampled containing testicular oocytes. Males ranged in age from one to three years old and all fish were examined for intersex. In conclusion, the presence of intersex among Spotted bass in the Chattahoochee River suggests that endocrine disrupting compounds may be present in the Chattahoochee River, which is a major source of drinking water for the residents of Columbus, Georgia. More research is needed in order to determine the background levels of intersex in Spotted bass.

P115 - Monitoring the Health of the Swan Lake Iris Gardens Ecosystem in Sumter, South Carolina

Pearl Fernandes, Daniel Kiernan

University of South Carolina Sumter, Sumter, SC

Swan Lake Iris Gardens is a black water lake with an abundance of wildlife. It is the only public park in the United States to feature all eight swan species. Swan Lake was chosen as the study site due to its proximity to USC Sumter and as no known study of the plankton community at Swan Lake had been conducted. The high level of biodiversity in the park is an ideal location to learn about different plants and animals and studying the plankton community would serve as an indicator of the health of this lake ecosystem. The objectives of the study were to identify some common phytoplankton and zooplankton in Swan Lake Iris Gardens. Sampling at Swan Lake Iris Gardens was conducted in the summer of 2018 using 100 micron-8" mouth diameter plankton nets. The nets were rinsed, thrown out from the shore to an approximate distance of 15 meters and dragged in. Samples (1000 ml) of surface and depth water was collected. Plankton were identified under the microscope and counted. Some initial results indicate the following trend: Phytoplankton outnumbering zooplankton at the lake surface and zooplankton outnumbering the phytoplankton toward the bottom of the lake. Some of our initial results indicate possibility of vertical migration of the zooplankton. We plan to explore this trend further through long-term weekly and diurnal sampling.

P116 - Assessment of microbial respiration and carbon loss rates in the upper Ohio River and selected tributaries in the Northern Panhandle of West Virginia

Emma McClelland, James Wood

West Liberty University, West Liberty, WV

Stream microorganisms can drive ecosystem processes, such as carbon cycling; however, changes in water chemistry can slow down or speed up the rate that carbon moves through the ecosystem. When microorganisms respire, inorganic carbon is released back into the system. In this study, we investigated the influence of water chemistry on microbial respiration and the breakdown of organic matter using two types of standardized substrates: labile cellulose sponge and recalcitrant red oak wood veneer. The rate of breakdown of these substrates correlated positively with increasing microbial respiration rates. Water chemistry data was used to assess for correlation with the microbial respiration rates. Specific conductance (SPC) was found to be a significant predictor model of microbial respiration rates; as SPC increased, microbial respiration rates increased. These correlations could provide us with new ways to predict the effects of stressors on multiple aspects of aquatic ecosystems, such as carbon cycling.

P117 - Habitat utilization and impact of flooding on James spinymussel (*Parvaspina collina*)

Christine Verdream

James Madison University, Harrisonburg, VA

Considering the ecosystem services that mussels provide and their high percentage of threatened species, specifically over half the freshwater mussels in Virginia, one avenue for future research could prioritize upstream mussels in downstream conservation plans. This project will provide information that could be applied to recovery plans for mussels in the James River watershed. In addition, the results will help bridge the gap between studies in freshwater and coastal systems through informing the release of propagated mussels to high survival habitats. Thus, increasing nutrient retention before reaching coastal systems. The objectives of the proposed research are: determine the relationship between flood disturbance and mussel population dynamics (abundance and variation through time), compare a stream with flood disturbance to a dammed stream without flooding to determine if flooding drives a source-sink dynamic, and identify habitat preferences for *Parvaspina collina*. Analysis will use a four-year mark-recapture data set for sites in the James River watershed. Including a comparison of immigration and emigration between flooding events. A population viability analysis will be conducted to quantify extinction to determine if transiency is resulting in a source-sink dynamic. Furthermore, habitat preferences will be determined between two streams through a comparison and analysis of substrate, base-flow, water depth and velocity, and distance to the stream bank in areas where mussels have persisted. Our observations suggest that

many mussels are temporarily occupying unstable habitats, understanding where mussels are most likely to survive and reproduce is crucial to identifying potential habitat and determining where propagated mussels should be released. Understanding the effect flooding has on *P. collina* populations can be vital in restoring the diminishing population and other endangered mussels in flood prone streams. Restoring populations will have positive ramifications for the filtration capacity of the populations of mussels in upland waters, benefiting nutrient retention downstream.

P118 - Investigating the Effect of Air Circulation in Plant Grow Beds on Arugula and Bibb Lettuce Productivity in a Freshwater Aquaponic System

Olivia Roddenberry[1], Heather Joesting[2]

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Aquaponics is a sustainable food production system that combines fish cultivation through aquaculture and plant production via hydroponics. Within the system, fish wastewater is utilized as fertilizer for the plants, while the plants remove excess nutrients from water that in high quantities can become toxic to fish. The cleaned water is then returned to the fish tank, thus eliminating the need for water changes in the fish tank and fertilizer additions for the plants. However, the high operating cost of aquaponics, such as electricity costs, has proven to be a challenge to the development of a sustainable aquaponics industry. Previous research on the effect of air circulation in plant grow beds on basil growth and productivity found significantly greater plant growth and biomass in plants grown in grow beds without air circulation. The aim of this study was to determine if this result is universal for all plant species or specific to basil. Bibb lettuce and arugula plants were placed in grow beds with and without air circulation and distributed throughout each grow bed in three locations: upper (nearest to fish effluent input), middle, and lower (near the collection tank). Plants were monitored weekly for plant growth and harvested at the end of four months for measurements of plant biomass. Data analysis is still on-going, but we expect to see a minimal effect of air circulation on plant productivity but a significant effect of location within the plant grow beds, based on the previous experiment with basil. The results of this study will provide valuable information on the necessity of air circulation in plant grow beds of an aquaponic systems and may provide an opportunity for savings in operating costs, therefore promoting the development of a sustainable and profitable aquaponics industry.

P119 - The Distribution and Ecology of Freshwater Sponges in Western North Carolina

Allison Griggs, David Corcoran, Joel Smith, Christina Strobel, Taylor Strope, Cara Fiore

Appalachian State University, Boone, NC

In western North Carolina little is known about the identification and distribution of freshwater sponges, or what factors drive their distribution. We have identified several freshwater sponge species at our collection sites in three major rivers near Boone, N.C. In May of 2017 we began monitoring the nutrients at two of our collection sites. We hypothesized that inorganic nutrients such as, nitrate, phosphate, sulfate, and chloride, may influence the distribution of freshwater sponges and the profile of these may be linked to land cover type. Inorganic nutrient analyses of water at each site indicated low nutrient concentration across locations and seasons. Chloride concentrations were the most variable, showing the most potential for influencing the sponge distribution. GIS was used to analyze the landcover around the rivers and a 100-yard buffer was used to visualize the landcover immediately around our collection sites. Preliminary analysis indicates a mix of hay pasture and woods, with some cultivated crops lands near each of our collection sites. Long-term monitoring and more collection sites are needed to better understand the influence that land cover may have on sponge distribution. It is clear however, that suitable bottom-type (i.e., large rocks) is critical for sponge colonization. We have also documented sponge-specific microbial symbionts that are specific to each location and may facilitate sponge survival in these oligotrophic habitats. These data are a first step in exploring freshwater sponge distribution ecology in western North Carolina. Future monitoring will include other parameters such as, temperature, pH, and conductivity, as well as exploring other potential sponge habitat.

P120 - A comparison of clearwater and blackwater streams in Fort Benning Military Installation, GA, using abiotic and biotic parameters.

Emma Davis, Mark Schimmer, Daniel Isenberg, Brian Helms

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Clearwater and blackwater streams are prevalent in the southeastern coastal plains of the United States. These stream types are often associated with local variation in geology, hydrology, and gradient. However, few studies have examined the biological variation in macroinvertebrate composition between blackwater and clearwater streams. The objective of this study is to determine differences in blackwater and clearwater streams using physicochemical, fish, and macroinvertebrate data. Representative reaches in eleven streams in Fort Benning Military Installation, Georgia, were surveyed in summer 2018 using standard methods. Five streams were clearwater and six streams were blackwater based on visual assessment. Reach-scale physicochemical parameters (temperature, pH, and conductance) were measured on site and basin-scale parameters (basin slope, mean channel slope, drainage area, relief, and relief ratio) were measured with USGS Stream Stats 4.0 software. Macroinvertebrates were identified to the genus level and counted, whereas fish were identified to the species level and counted. We found significant differences in three basin-scale parameters, as well as pH. There was significantly higher Simpson's diversity and species richness of fish in blackwater vs. clearwater streams. Fish assemblage composition varied between stream types with *Pteronotropis euryzonus* predominant in blackwater streams and *Semotilus thoreauianus* in clearwater streams. However, no significant difference was found in the Shannon diversity, richness, or abundance of macroinvertebrates in blackwater vs. clearwater streams. These preliminary analyses suggest that, although physicochemically similar, biotic differences associated with these two stream types are more evident in fish assemblages than macroinvertebrate assemblages.

P121 - Habitat Selection Across Temperature and Nutrient Gradients

Sarah McNamara, William Resetarits

University of Mississippi, University, MS

Habitat selection by oviparous species for their offspring is critical for larval survival and performance, and parental fitness since there is typically little parental care beyond oviposition site choice. The perceived quality of a habitat by adult females may shift as changes in global climate increase water temperatures and rates of eutrophication, affecting species with different life histories in various ways. Three outdoor mesocosm experiments were conducted using two species with complex life cycles and very different life histories; Cope's Gray tree frog (*Hyla chrysoscelis)* and the mosquito *(Culex restuans)*. To test the oviposition site choice of each species, a gradient of temperatures and nutrients were established in mesocosms and left open for oviposition. To test if Cope's Gray treefrog oviposition site choice matched larval performance, a third mesocosm experiment measured frog metamorph body metrics after being reared in each of the temperature and nutrient treatments. Determining the current oviposition preference and performance of these species could help inform questions about future species distribution and population sizes as global warming and eutrophication affect the quality of freshwater systems.

P122 - Structural and biological diversity in the Lee Branch stream on the Midway University Campus: an additional look

John Delfino, Guipsy Lopez

Midway University, Midway, KY

Two reaches of the Lee Branch stream flow on the Midway University Campus and are surrounded by natural terrestrial habitat. Benthic macroinvertebrates are biological indicators of water quality. In summer 2016 we determined both reaches were in fair biological condition, and water quality at benthic macroinvertebrate sites generally was within Kentucky's acceptable range for aquatic life. With this summer 2016 data in hand, here we calculated diversity and evenness indices for habitats, microhabitat combinations, and benthic macroinvertebrates in each reach and wanted to compare these respective indices for reach 1 and 2, provided rarefaction analyses supported comparisons. For each reach we identified and quantified aquatic habitats as riffles, runs, pools, and glides, where we generally randomly sampled each. Within habitats across reach bank to bank, we always sampled midstream; otherwise, sample sites were generally randomly determined, where we identified and

quantified microhabitat combinations and collected benthic macroinvertebrates using a D-frame net. Invertebrates were brought to the lab for identification and preserved, while crayfish were released. For stream reach 1 we found: habitats (Shannon diversity index = 0.69315, Simpson's diversity index = 0.57143, Shannon evenness index = 1.00000); microhabitat combinations (1.49420, 0.85714, 0.92838); benthic macroinvertebrates (0.95690, 0.36810, 0.31430). For stream reach 2 we found: habitats (1.15500, 0.68000, 0.83316); microhabitat combinations (3.31110, 0.97039, 0.93895); benthic macroinvertebrates (1.36020, 0.54399, 0.43381). Rank-abundance curves are given for visualization of richness and evenness. Reach 1 (≈237 m) supported 2 habitat types, 5 microhabitat combination types, and 21 benthic macroinvertebrate groups. Reach 2 (≈1338 m) revealed 4 habitat types, 34 microhabitat combination types, and 23 benthic macroinvertebrate groups. Rarefaction curves describing habitat types, microhabitat combination types, and benthic macroinvertebrate groups in all cases precluded reasonable comparisons of reach 1 and 2, leaving open the possibility that increased sampling effort could have influenced our reach 2 findings.

P123 - Evaluating Stream Restoration Program Effectiveness Using Benthic Macroinvertebrates as a Proxy for Stream Health

Lucas Manweiler, Brian Anderson, Cameron Baker, Andrew Douglas, Haley Grove, Rhett McBrayer, Nicole McCroddan, Kathryn Motley, Andrea Navarro, Brittany Sweet, Bruce Wiggins

James Madison University, Harrisonburg, VA

The Conservation Reserve Enhancement Program (CREP) aims to maintain environmental integrity in agricultural areas of Virginia, such as the Shenandoah Valley, by incentivizing land owners to block off streams from livestock and replant riparian buffers. These programs have become very popular, but there has been little research into the effectiveness of their restoring ecosystem health. With this discrepancy in mind, our research evaluated the effectiveness of riparian buffer programs by studying the factors of time elapsed since restoration and stream health based on the Virginia Stream Condition Index (VSCI). We hypothesized that that the length of time the buffer has been in place has an effect on the VSCI score of a stream and predicted that streams with older buffers will have higher VSCI scores. The health of the streams was evaluated by collecting benthic macroinvertebrates in a one meter^2 net and identifying invertebrates to family, based off the VSCI. Streams were then plotted in GIS to evaluate each stream's watershed area, and to determine time since restoration implementation, land cover types, and road and stream density inside the restoration sites' watersheds. A 100 meter buffer was determined for the streams as well, and single variable and multiple variable linear regression analyses were performed within watershed areas and buffer zones. Regression analysis showed that time since restoration implementation and higher amounts of forested land cover up-stream led to higher VSCI scores inside stream buffers and within stream watersheds. These data showed that restoration programs do have a positive effect on the health of a stream, but that land-use upstream of the restoration project has an effect as well.

P124 - Response of General Esterase and Glutathione-s-Transferase Enzymes to MCHM Exposure in the Fathead Minnow, *Pimephales promelas*

Erin Burke

Southern Adventist University, Collegedale, TN

Enzyme catalysis of xenobiotics is one of the most powerful indicators of toxicological response. General esterase and glutathione-*s*-transferase enzymes possess a wide range of exogenous functions; disruption of these enzymes suggests a serious risk to several biochemical pathways. In 2014, several thousand gallons of 4-methyl-1-cyclohexanemethanol (MCHM) spilled into the Elk River in West Virginia. Although multiple studies have presented the effects of MCHM exposure on humans, little attention has been given to the aquatic biota in the contaminated water. I exposed fathead minnows, *Pimephales promelas*, an environmentally-relevant species, to five concentrations of MCHM (50 ppm, 20 ppm, 10 ppm, 5 ppm, and a 0 ppm control). Spectrophotometry was used to collect data on the specific activity of general esterase and glutathione-*s*-transferase enzymes in whole-body homogenates. I expect to see a significant difference in specific enzyme activity between experimental groups, both from each other and from the control. If specific activity is disregulated, it will show that MCHM exposure can affect the exogenous function of these enzymes.

P125 - Assessment of a Thirteen-Year-Old CREP Restoration Project at Smith Creek, Rockingham County, Virginia

Morgan Hussey[1], Hannah Macmillan[1], Jacob Peters[2], Sara Schoen[3], Christine Verdream[1], Heather Griscom[1]

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Riparian ecosystems are biologically diverse and crucial for mitigating the impacts of agriculture on waterways. Historic deforestation and unsustainable farming practices have degraded these ecosystems and restoration efforts are being made to restore forested buffers around streams. An understanding of factors responsible for the success or failure of restoration projects is lacking because restoration projects are rarely monitored. This study is an assessment of a restoration project on Smith Creek which is part of the Conservation Reserve Enhancement Program (CREP) in Virginia. The goal was to evaluate planted tree survival and size (diameter at breast height) and provide suggestions for future CREP projects. Over twelve thousand seedlings, representing ten species, were planted on 65 acres in 2005-2006. A random six-acre section of the farm (1.5 total acres) was sampled with transects ranging from 0–100 meters from the stream. After fifteen years, tree species were not significantly different in size, although the largest individuals, found 15–30 meters from the stream, were sycamore (*Platanus occidentalis*) (dbh_{max}=29.9 cm). Although sycamore mortality increased with distance from the stream, significantly more sycamores were encountered than the other species (χ^2=25.92, $p<0.001$). Despite four-foot plastic tree shelters, heavy deer browsing—especially on red oak (*Quercus rubra*)—limited tree survival and growth. A few *Quercus rubra* reached heights above deer browse level, perhaps because they were protected from native vegetation. For future projects, we suggest planting more riparian species, such as sycamore, and fewer oaks that are vulnerable to deer browse. In addition, we recommend collecting data on a subsample of permanently tagged trees at the time of planting.

P126 - Competitive interactions between stream salamanders and crayfish in the southern Appalachian Mountains

Susan Cragg[1], Josh Ennen[2], Kristen Cecala[3], Jon Davenport[1], Shawna Mitchell[4]

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Anthropogenic-induced shifts in climate and changes to natural landscapes are impacting the structure and function of ecosystems globally. These changes can be especially perilous for some freshwater organisms due to their specific niche requirements and physiological constraints. Furthermore, reductions in the availability of suitable habitat for these species may influence competitive interactions between organisms that require similar resources. Stream salamanders and crayfish often consume the same prey items and utilize the same refuges (i.e. rocks, fallen trees, and burrows) for protection, ambushing prey, nesting, and anchoring. Considering these similarities, these two taxa may compete for interstitial spaces, especially when critical resources are limited. Yet, little is known about species interactions among stream salamanders and crayfish in the southern Appalachians. Therefore, we conducted an artificial stream experiment to investigate how the strength of interactions between black-bellied salamanders (*Desmognathus quadramaculatus*) and Appalachian brook crayfish (*Cambarus bartonii*) varies with spatial refuge availability. We hypothesized that 1) crayfish presence would negatively affect salamander growth and survival due to their aggressive behavior, 2) the strength of interactions would be more intense with fewer spatial refuges, and 3) the degree of cohabitation would be lower between crayfish and salamanders than between subjects of the same species. Our preliminary results indicate that neither cover object density nor species identity affect cohabitation probability. Future analyses will analyze changes in body condition to assess the strength of species interactions. Baseline information on cohabitation and species interactions will be instrumental for understanding and predicting future community changes.

P127 - Spatially Explicit Habitat Selection: Contagion and the Ideal Free Distribution

Reed Scott[1], William Resetarits[2]

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Habitat selection is a phenomenon of interest to a wide variety of researchers due to implications for conservation, ecology, and evolutionary biology. Globally, species are facing an unprecedented loss of habitat through habitat destruction and fragmentation. As we attempt to assess the effects that habitat loss will have and how best to mitigate any damage, it is vital that we understand how species interact with and actively select their habitat. The Ideal Free Distribution (IFD) has been a pillar of ecology, and formed the basis for our understanding of population dynamics and habitat selection. The IFD assumes that individuals have perfect information about all habitat patches in a system (they are ideal) and that individuals can select any habitat patch within a system (they are free). The IFD predicts that individuals should select the habitat patch with the highest quality, or the patch that will maximize their fitness, and increasing density of conspecifics will negatively impact habitat quality. Previous research has shown overall support for the IFD, but experimental systems have varied in how stringently they adhere to the IFD. Additionally, a new ecological phenomenon known as Spatial Contagion seems to contradict the IFD. Spatial Contagion is a phenomenon in which the perception of one habitat patch affects the perceived quality of neighboring patches. This creates in issue for the IFD, as individuals are misperceiving cues and thus do not have perfect information, violating the assumption of ideality. In my poster I will be outlining the experiments I plan to conduct, which will test the IFD's prediction that conspecific density can affect perceived habitat quality and will test the interaction between the IFD and Spatial Contagion.

P128 - Histopathological comparison of livers of Largemouth bass (*Micropterus salmoides*) from the Chattahoochee River and a tributary, Columbus, Georgia

Amy Sibley, Elizabeth Klar, Michael Newbrey

Columbus State University, Columbus, GA

Environmental health can be measured in various ways including number and presence of certain macroinvertebrates, presence of harmful bacteria, dissolved oxygen values and other forms of direct water chemistry. Fish health can also be used as a proxy for health of a waterbody. The presence of pollution can be inferred in fish because the liver acts as a detoxication center for the body and contaminants cause damage to liver cells. The goal for this preliminary study is to quantify the damage and therefore deviation of liver cells from a healthy state in Largemouth bass (*Micropterus salmoides*). We compared the livers of fish from Chattahoochee River (n=30) and nearby Lindsey Creek (n=30) to assess health. The Largemouth bass were anesthetized, and the liver removed, weighed, and a portion preserved in 10% neutral buffered formalin. The tissues were processed using normal histological procedures and stained with hematoxylin and eosin. Liver sections (i=10 per fish) are collected non-serially and examined for changes in tissue structures from a normal state. Using a semi-quantitative index, degree of tissue change (DTC), we assess liver health by identifying presence of alterations in the tissues. This method classifies alterations of the tissue based on the severity of cellular and tissue damage into three stages each with different parameters (p): stage I (p=9), stage II (p=7), stage III (p=1). The average DTC is 70 (range 28–152) for Largemouth bass (n=6) from the Chattahoochee River (n=6). The average DTC is 40 (range 14–81) for Largemouth bass (n=5) in Lindsey Creek. The river has greater non-point source pollution potential than the creek, and therefore, livers from the Chattahoochee River are expected to have higher DTC values when compared to those from the creek.

P129 - Intensity of trematode infection and body size are positively correlated to nematode infection in Western Mosquitofish

Megan Gibbons, Lindsay Higgins

Birmingham-Southern College, Birmingham, AL

Parasites can have profound impacts on their hosts, including alteration of a host's susceptibility to secondary parasite infection. *Gambusia affinis* (Western mosquitofish) is a known host of at least two parasites: the trematode (*Uvulifer sp.*) that causes Black Spot Disease (BSD) and an internal nematode parasite *Eustrongylides ignotus*. We investigated whether intensity of infection by BSD was associated with a higher occurrence of *E. ignotus* in this species. We predicted that fish with more "spots" would be more likely to be infected with *E. ignotus*. In support of our prediction, we found that intensity of infection by *Uvulifer sp. (number of spots)* was positively associated with presence of *E. ignotus*, as was larger host body size. These results suggest a positive relationship between co-parasitism of *Uvilifer. sp* and *E. ignotus*, but the relationship may be due to the tendency of both BSD and *E. ignotus* infection to increase with body size in *G. affinis*.

P130 - Salinity Stress Response of Rock Crayfish (*Cambarus carinirostris*)

Addie Shanor[1], Zachary Loughman[2], James Wood[3]

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Salinity levels of freshwater streams in the eastern United States are rising at a rapid rate primarily due to the increased use of road salts on roadways throughout the cold seasons. This increase in salinity has led to habitat degradation in aquatic ecosystems and a harmful effect on the health of the freshwater organisms. To better understand the effects of salinity on freshwater organisms we investigated the effects of increased salinity on the Rock Crayfish (*C. carinirostris)* by measuring the change in respiration rate. We exposed *C. carinirostris*to various concentrations of salinity and tracked changes of dissolved oxygen levels over time. Respiration rate was corrected for crayfish ash free dry mass and regressed against salinity. Crayfish responses to salinity may be indicative of how other freshwater macroinvertebrates react to increased salinity levels.

P131 - A comparison of salamander communities in a managed section versus an impacted on-campus section of a Northwest Georgia first order stream

Kaytlin Pepper, Brittany Flood

Dalton State College, Dalton, GA

Dalton State College sits at the base of Dug Gap Mountain in North Georgia and includes managed terrestrial and stream habitat within its campus borders. From 2017 to 2019, a community study was conducted in portions of stream reaches and associated terrestrial habitats to investigate salamander species diversity and habitat use. A comparison was made between sections of the stream that received little human impact with those that were directly impacted by human disturbance. We sampled 35-meter-long sections of stream and adjacent terrestrial habitat four days a week using traps, hand capture, and coverboard arrays. Meteorological and sound pollution data were collected daily and morphological data was documented for each specimen captured. As hypothesized, the protected site contained more specimens total than the on-campus site with a 33% increase. The total species count for both has increased from four to six since the 2017-2018 collection period. *D. fuscus* and *D. monticola* prevailed as 80.3% of the population in the upper site and 75.0% in the lower with *E. cirrigera*, *P. glutinosus*, *P. ruber*, and *P. serratus* following in said order.

P132 - Does the quality of symbiosis between green alga (Oophilia amblystomatis) and spotted salamander (*Ambystoma maculatum*) embryos affect morphology and performance of larvae?

Caroline Kennedy[1], Mischa D'Errico[2], Rebecca Hale[1]

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Symbioses between organisms can be limited to one stage of an organism's life or persist throughout the organism's lifetime. Symbioses that occur during only part of an organism's life cycle may have long term consequences for later life stages. Even when advantages of high quality mutualisms during early developmental stages are clearly determined, how these early benefits affect later stages absent of this symbiosis may be difficult to elucidate. In the relationship between spotted salamander (*Ambystoma maculatum*) embryos and the green alga, *Oophila amblystomatis*, the alga has been shown to provide oxygen and fixed carbon to embryos. Additionally, having egg membranes with higher algal density results in faster development and greater length in embryos. How variation in egg capsule algal density contributes to variation in larval morphology and performance, has not been investigated. Here, we examine the relationship between algal cell density, hatchling morphology, and hatchling performance. Individual egg capsules and larvae were collected upon hatching from egg masses reared in the field. Algal density was quantified for each capsule and corresponding larvae were measured and tested for swim speed. We hypothesized that higher egg capsule algal cell density would be correlated with decreased time to hatching, longer tail length, and greater swimming speed relative to hatchlings that developed with fewer algal cells.

P133 - The effects of a stream restoration project on condition factor, growth, and diet of Bluegill Sunfish (*Lepomis macrochirus*)

Jake Hollows, Mason Ferrell, Tom Blanchard

University of Tennessee at Martin, Martin, TN

The channelization and straightening of rivers and streams are known to have a host of adverse effects on hydrology as well as aquatic biota. Over the past 10 years in West Tennessee, the West Tennessee River Basin Authority (WTRBA) has implemented several stream reconstruction projects in an effort to enhance sediment transport and to alleviate problematic flooding. As part of the reconstruction process, natural meanders were re-established within designated reaches in order to mimic the typical morphology of streams in this region. Although monitoring of habitat features and fish community structure has been extensive in restored streams of West Tennessee, there have been no studies examining the effects of stream reconstruction on the biology of any particular species. In this study, we examined the effects of stream reconstruction in Crooked Creek (Carroll County, TN) on the condition factor, growth, and diet of Bluegill Sunfish (*Lepomis macrochirus*). In the summer of 2018, we collected Bluegill from two sites; one within a 2-km length of reconstructed stream, and the other, an upstream site that remains in a channelized condition. Mean condition factor of Bluegill collected from the reconstructed site was significantly lower ($p < 0.05$) than that of Bluegill from the channelized reach. Preliminary examination of estimated growth rates indicated only slight differences between the two populations. For some age classes however, mean standard length appeared to be higher in fish from the channelized site. Diet analysis of the two populations has not been completed.

P134 - Assessing Water Chemistry Trends in the Upper Ohio River Watershed

Haley Miller[1], Emma McClelland[1], Emily Huff[2], James Wood[1]

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The Upper Ohio River Watershed has been a major industrial region since the late 1800s. The historical impacts have resulted in poor water quality in the tributaries to the Ohio River. Today, many of the tributaries are used for recreational purposes and the Ohio River mainstem is used for municipal drinking water. Public health concerns provided motivation for more surveillance and analysis of chemical components in the water. To improve the water quality in the Upper Ohio basin, water chemistry of the tributaries needs to be investigated to identify trends, primary stressors, and longitudinal changes in water quality. Since February of 2018, 321 samples have been taken in the Upper Ohio River watershed recording, conductivity, dissolved oxygen, pH, and water/ air temperature. Conductivity at the mouth of the tributaries, Short Creek (mean = 856.3, SE = 100.0) and Wheeling Creek (mean = 409.3, SE = 14.9), have been consistently higher than the Ohio River mainstem (mean = 283.2, SE = 8.9). The mean conductivity for Short Creek increased longitudinally towards the mouth (R2 = 0.4). Whereas, the mean conductivity for Wheeling Creek remained fairly constant between upstream and downstream sites (R2 = 0.1). Though the mean conductivity of the Ohio River is lower than it's tributaries, there is concern that the poor water quality of Short Creek and Wheeling Creek may be detrimental the Ohio River's health.

P135 - An ecological assessment of the four major streams in West Virginia's Northern Panhandle

Garrett W. Hoover, James Wood

West Liberty University, West Liberty, WV

The Northern Panhandle is a culturally distinct, historically foundational region of West Virginia. The northernmost extension of the state is bordered by Pennsylvania to the east, and the Ohio River to the west. Lying centrally within the Allegheny Plateau, its terrain is characterized by razorback ridges and steep, winding valleys, producing a dendritic stream pattern that drains westward into the Ohio River. This high-density stream network is nested within the urban centers of the Upper Ohio Valley; coupled with the region's intensive coal, oil and gas resource extraction, surface waters are at an elevated risk of degradation from both historical and modern sources. A paucity of biological water quality assessment has been conducted for streams in the Northern Panhandle, leaving our understanding of current impairments poorly understood, and our ability to evaluate restoration

opportunities uncertain. We propose a comprehensive ecological assessment of the four major streams in West Virginia's Northern Panhandle. Kings Creek and Buffalo Creek each comprise their own HUC-12 and HUC-10 watersheds, respectively, have less-developed catchments, and are more highly recreated. Short Creek and Wheeling Creek also comprise respective HUC-12 and HUC-10 watersheds, but have more heavily urbanized catchments from the cities of Wheeling and Triadelphia. Our goal is to understand if significant changes occur as they flow across the Northern Panhandle into the Ohio River. Site locations will be placed throughout the West Virginian portion of their reach: at the West Virginia/Pennsylvania border, at mid-reach, and at their confluence with the Ohio River. We will assess how land use affects water quality, macroinvertebrate biodiversity, functional feeding groups, and biomass. This study will provide valuable information for conservation groups working to protect water quality and improve the potential for recreation and tourism in the Northern Panhandle.

P136 - Accidental biocontrol agent or just another invader?

Sara Osorio, Loretta Battaglia

Southern Illinois University, Carbondale, IL

Interactions between species that lack a recent evolutionary history are highly unpredictable. For example, the outcomes of interactions between native and exotic species run the gamut from benign to widespread ecosystem degradation. Interactions between species that are both aliens to their introduced range, and to each other, may be positive, neutral, or negative. In contrast, exotic species that share an evolutionary relationship may exhibit more predictable "old interactions", indicative of historic relationships, in their introduced range. The largest freshwater snail in the world is the Giant Apple Snail (*Pomacea maculata*), a generalist herbivore native to South America. After its introduction to the southeastern U.S., the snail's high fecundity promoted rapid invasion in many wetland ecosystems where it can have detrimental effects on water quality, native macrophytes, and potentially higher order consumers. *Salvinia minima* and *S. molesta* are aquatic ferns that are also highly invasive. They form dense, floating mats that displace native plants, block sunlight and reduce dissolved oxygen levels in the water column. These ferns not only co-occur with *P. maculata* in parts of their joint native ranges, but also their joint introduced range. Few studies have been conducted on interactions between introduced species that share an evolutionary background but also overlap in their new range where they are now invasive. We hypothesized that the snail would be more accustomed to the invasive ferns and would therefore preferentially consume them over the novel, native plants (*e.g.*, *Lemna minor*). Our study site is in the backswamp at Barataria Preserve at Jean Lafitte National Historical Park and Preserve, Jefferson Parish, Louisiana, USA. In Summer 2019, we will conduct a food preference study using enclosures in the field. Renewed herbivory of the ferns, which lack an effective biocontrol in this system, should lead to increased abundance of native plants.

P137 - Chronological age and the prevalence of intersex within Largemouth bass (*Micropterus salmoides*), lower Chattahoochee River near Columbus, Georgia

Jeramy Belt, Elizabeth Klar, Abigail Abernathy, Meenal Joshi, Michael Newbrey

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Previous studies have shown the presence of intersex in Largemouth bass (*Micropterus salmoides*) of the Chattahoochee River; however, the potential relationship between age and intersex is still unknown. Intersex is a phenomenon where a gonochoristic organism shows the gonadal tissue of the opposing sex. We hypothesized there would be a positive correlation between age and the prevalence of intersex because older fish have potentially longer cumulative exposure to endocrine disrupting compounds (EDCs). Largemouth bass were collected from the Chattahoochee River to assess the prevalence of feminization. Fish were collected using electro fishing boat methods and thin sections of gonadal tissue examined for prevalence of intersex. The sagittal otolith was extracted, and age was determined. Male Largemouth bass were collected from the Chattahoochee River and intersex was identified in 14 (77.78%) of males examined (n=18). Largemouth bass ranged in age from 1 to 6 years old. Sizes varied from 18cm to 57cm and weight varied from 57g to 2901g (n=18). Oocytes were identified in gonads of individuals, which ranged in age from 2-6 years old. Our preliminary data shows no correlation between age and the prevalence of intersex (Pearson correlation: $r= 0.100$, $p=0.560$). Moreover, Largemouth bass exhibit intersex at even younger ages. However, our current sample size is small and lacks older individuals. Largemouth bass commonly live up to 16 years old, but they can attain a maximum age of 23 years. Our preliminary data show

that Largemouth bass in the Chattahoochee River exhibit intersex at sexually mature ages. Moreover, Largemouth bass exhibit intersex at even younger ages. Our next goal is to address whether there are cumulative effects of EDC's by testing for a relationship between severity of intersex and age.

P138 - Comparison of benthic macroinvertebrate assemblages in a mitigated urban stream and a control stream in Chattanooga, Tennessee

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In a preliminary experiment, we compared the taxonomic composition and diversity of benthic macroinvertebrate assemblages in a mitigated stream (mitigation site) with that in a non-mitigated stream (control) in Hamilton County, Tennessee. The mitigation site is located on a tributary in the upper watershed of Citico Creek (Tennessee River drainage). In 2001, a mitigation project was completed to address water pollution issues in a channelized, concrete-lined stream section of the Citico Creek system. The mitigation involved removal of concrete from 925 m of the stream channel, followed by the installation of a series of rock weirs in the channel to promote grade and flow deflection. The control site is a non-mitigated tributary of Mountain Creek. Both sites were established on second-order Ridge and Valley streams. In September 2018, we used a Hess sampler to collect data on benthic macroinvertebrates in riffle habitats in the two study reaches; three riffles were sampled at each site. Overall, 8 families of invertebrates were found at the mitigation site (n = 462 individuals) versus 16 families at the control site (n = 849 individuals). EPT (Ephemeroptera + Plecoptera + Trichoptera) family richness was 3 at the mitigation site and 6 at the control site. Macroinvertebrate assemblages exhibited different taxonomic compositions at the two sites (chi-square test; $P < 0.0001$). Relative abundances of EPT taxa were 2 % and 54 % in samples from the mitigation site and control site, respectively. Chironomidae abundances were 49 % and 5 % in composite samples from the mitigation and control sites, respectively. These data provide the first evidence of EPT taxa at the Citico Creek mitigation site; however, comparisons with the control site indicate that stream water quality is impaired in the upper watershed of Citico Creek.

P139 - Long-Term Carbon Retention of Restored Sandy-Bottom Streams at Fort Benning Military Installation

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Long-term efficacy of stream restoration efforts is often unknown due to logistical and funding constraints. Using a stream restoration effort initiated on Ft. Benning, GA in 2002 as a baseline, we quantified the long-term effects of the addition of in-stream debris dams on benthic particulate organic matter (BPOM), coarse woody debris (CWD), and dissolved organic carbon (DOC). Four streams received z-shaped debris dams in 2003 and were then compared to 3 unrestored streams to determine the long-term (>10 years) effects of stream restoration. During 2017, BPOM was quantified as ash-free dry mass from 6 sediment samples at five transects throughout a 100 meter representative reach at each site. All CWD greater than 2.5 cm in diameter was counted and measured within 15 equally-spaced cross-channel transects at each site during summer 2018. Monthly DOC was quantified using high-temperature combustion catalytic oxidation methods from summer 2017 to summer 2018. Average BPOM was not significantly different between restored and unrestored sites. Results of CWD and DOC data also showed no significant difference between treatments. Preliminary findings of this study appear to show a limited long-term effect of restoration efforts across multiple streams. This is likely explained by the inherent variation and idiosyncratic nature of these stream systems. Further research on this restoration approach, including analysis of additional response variables, is warranted.

P140 - Analysis of tree mortality in carbon offset plantings in central NC

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Between 2016-2017, over 1,000 trees were planted in North Carolina's Piedmont physiographic region as part of three carbon offset programs: Delta Airlines (Delta), Duke University (W&G), and Elon University (Price Park). Over the next 40 years these trees will sequester carbon, after which the

sequestered carbon can be sold or used as an offset credit. The purpose of this research is to conduct a site verification of each tree in order to determine the first-year mortality rate of the trees in each planting, and to estimate the amount of carbon sequestered after 40 years. Verification was conducted per the Duke Carbon Offset Initiative (DCOI) protocol. Urban plantings such as these have an expected mortality rate of 3-8%, and we hypothesized that the observed mortality rate after one year would fall below this range. Our results showed that there were significant numbers of missing or misidentified trees for the Delta project. Furthermore, we found that the mortality rates for trees planted in each project were: Delta 21%, W&G 7.1%, and Price Park 5.9%. As a result of the excessive mortality rate of the Delta project, the project could not be validated for carbon offset purposes. Across all sites, we identified lack of control over planting techniques, drought, and buck antler rubs as significant causes of mortality. We calculated that in 40 years 278 MtCO2e is expected to be sequestered in Price Park, 447.91 MtCO2e in the W&G project and 6,545.9 MtCO2e in the Delta project. Our hypothesis was not supported by our results because the mortality rates at each site exceeded the 3% threshold in all projects. Our research into patterns of mortality and their effect on carbon sequestration will help to guide future sequestration projects in the Piedmont physiographic region.

P141 - Evaluation of secondary successional changes in Elon University Forest after the ice storm of March 2014

Madeline Turnau, David Vandermast

Elon University, Elon, NC

A storm on March 6th, 2014 brought unusually heavy ice and snow to Elon, North Carolina. Data was collected in the Elon University Forest (EUF) during 2018 and compared to data from 2010 and 2014 to understand how this storm affected ecological succession. EUF is a patchwork of different ages, ranging from 50 years to areas called “forests of continuity” that have never been clear cut. The 2014 study found significant mortality and damage to Virginia pine (*Pinus virginiana*) suggesting that storm-caused changes to the forest were primarily driven by changes in abundance of this species. The present study seeks to determine whether the storm increased the rate of secondary succession in EUF. Data were collected on eight permanent plots using standard Carolina Vegetation Survey (CVS) protocol. Our results indicate that EUF continues to lose Virginia pine and gain assorted hardwood species. As a result there is has been an increase in Shannon diversity (2.43 to 2.54), tree density (552.5 to 571.3 trees/ha), and basal area (32.6 to 33 m2/ha), since 2014. Our results also show that the storm resulted in a significant decrease in tree density from 2010 to 2014 (622.5 to 552.5 trees/ha, $p<0.01$) and that, despite the recent increase, tree density in 2018 is still significantly lower than it was in 2010 (622.5 vs 571.3 trees/ha, $p<0.01$). The annualized mortality rate for Virginia pine was 5.6 trees/ha/yr for the four years prior to the storm and has been 4.1 trees/ha/yr after it. The changes we have observed indicate that EUF continues to recover from the storm but that changes to the forest are not occurring more rapidly than they were prior to it.

P142 - Response of Restoration Chestnut Seedlings to Forest Management Strategies

Zoe Bergman, Cassie Stark, Heather Griscom

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The American Chestnut (*Castanea dentata*) was once a dominant canopy species in Eastern forests of the United States. A pathogenic fungus *(Cryphonectria parasitica)* decimated this tree species to functional extinction over sixty years ago. Our research attempts to identify forest management strategies for increasing the success of hybrid chestnuts (Restoration Chestnuts 1.0) plantings in forested ecosystems. We manipulated factors that may facilitate seedling survival and growth in an Appalachian cove forested ecosystem in West Virginia. We created canopy gaps of different sizes (40% vs 60% canopy openness) to manipulate light with the prediction that seedlings would perform best in large gaps (~60% canopy openness), Within these gaps, we added landscape fabric on every other row to decrease vegetative competition. We placed 12” tree shelters around half of the seedlings planted within the gaps to protect them from rodent predation. All gaps were surrounded by 7 foot tall deer fences. After four years, seedlings had significantly greater diameter and survival (68.5%) in small gaps ($p < 0.001$). In comparison, only 47% of seedlings survived in large gaps across all treatments. Tree shelters and landscape fabric had no significant effect on planted seedlings in small gaps. However, in large gaps, landscape fabric had a positive effect on seedling height and diameter ($p< 0.05$). *Rubus* spp. physically crushed the seedlings and reduced light levels

in higher light conditions. The landscape fabric protected seedlings from *Rubus* spp. to a certain extent but may have also provided shelter to rodents and/or increased humidity levels, thereby increasing root rot. In conclusion, we recommend planting chestnut seedlings in small gaps without landscape fabric or tree shelters. Chestnuts compete best under these conditions in an Appalachian cove ecosystem.

P143 - Precipitation Event Size Controls on Autotrophic and Heterotrophic Respiration in a Desert Grassland

Zoe Bergman

James Madison University, Harrisonburg, VA

Soil carbon efflux has two major contributors, autotrophic and heterotrophic respiration. In past studies, it has been found that microbial respiration will peak at small rainfall pulse events and level off even as rainfall increases, while plant respiration tends to increase as rainfall size increases. We predicted that microbial respiration would spike in response to small rainfall event sizes but remain level as rainfall event size increased. In contrast, plant root respiration (intact soil treatment) would continually rise as rainfall event size increased and that post-rain respiration would remain at elevated levels for longer. In addition, we predicted drought plots would have significantly lower soil respiration than irrigation and control plots. In order to test these predictions, we used a field manipulative experiment where we had 3 rainfall treatments; drought (-80% of rainfall) through rainout shelters, increased precipitation through irrigation (+80% rainfall), and control. We also nested two soil manipulation treatments, sieved soil to remove roots and intact soil treatment. We measured daily soil respiration after each rainfall events for 10 days throughout the growing season. Results supported our predictions; soil respiration in drought treatments was significantly lower than both irrigated and control treatments ($p < 0.04$). Intact soil treatments had significantly higher soil respiration than sieved treatments ($p < 0.001$). Soil respiration rates in sieved soil treatments were significantly lower than intact soil respiration rates; plant root respiration spiked in response to larger rainfall events while microbial soil treatments plateaued despite increases in precipitation.

P144 - Habitat Interactions of Wet Pine Savanna

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The Mississippi sandhill crane, *Grus canadensis pulla,* is a federally endangered crane subspecies found in the wild only on the 2,100 hectares of wet pine savanna in and around the Mississippi Sandhill Crane National Wildlife Refuge. The refuge population has been supplemented by release of captive-reared cranes since 1981, but low recruitment, primarily due to low chick survival, has prevented the population from becoming self-sustaining. The purpose of this study is to quantify the interactions between habitat parameters relevant to crane use, such as primary production, abundance of major food items such as Orthoptera, and predator activity. Preliminary results show no clear relationship between annual aboveground net primary production (ANPP) and total arthropod biomass but estimates of Orthoptera abundance show a significant interaction with prescribed fire management of the refuge. Mean number of Orthoptera per square meter detected in transect surveys of areas burned less than one year prior to sampling was more than double that of areas burned three or more years prior to sampling. Abundance of adult Orthoptera appears to be more closely related to vegetation quality rather than quantity, which may explain their greater abundance on recently burned sites. Predators were detected with roughly equal frequency between units, independent of fire schedule, ANPP, arthropod biomass, and Orthopteran abundance.

P145 - Pu'uwa'awa'a: Restoring a Tropical Dry Forest on the Big Island of Hawai'i

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Pu'uwa'awa'a Forest Reserve, an area that was once used as ranchland on the Big Island of Hawai'i, contains the Haua`ina restoration site. This site is used for outplanting of Hawaiian native plants to restore its natural state as a lowland tropical dry forest, one of the most endangered ecosystems on the planet. This work is achieved by clearing out invasive species and reintroducing native plant species to the site using data and historical evidence from the surrounding area. Success of the

restoration effort is checked by monitoring species survivorship and prevalence in the restoration area. In 2015, 13 transects were set up throughout the restoration area. Each transect is 20m long and 2m wide. Woody plant species with their stems in the transect area were counted annually from 2015 through 2018. Here we compare data from the 13 transects from 2016 to 2018, survey periods conducted as part of the Campbell University Hawaiian Ecology and Culture Program. Shannon Diversity, species richness, and survivorship are compared between the two years. In regards to species richness, no transects changed dramatically from 2016 to 2018, as richness either remained the same over time or only fluctuated by 1. Six transects decreased in diversity, while 7 increased in diversity. In 2016, average transect diversity was 1.2272, and in 2018 it was 1.1973, a negligible change. Approximately half of the inventoried species showed no change in survivorship. Twenty percent of the species rose in survivorship while 32% fell. Kukui (*Aleurites moluccana*) and lama (*Diospyros sandwicensis*) had the largest increases in survivorship, while 5 other species had disappeared from the transects by 2018. Changes in survivorship may be due to natural decline or sampling error. These data can be used in the future in efforts to monitor, preserve, and restore these rare ecosystems.

P146 - The Effects of Prescribed Burning on Herpetofaunal Communities in the Shoal Creek District of the Talladega National Forest

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Fire has been recognized as an important component of southern forest ecosystems. The burning process effects elements of competition and mortality in plant communities as well as removes dead and low standing vegetation in the understory. The clearing of understory during a burn may have an effect on the biodiversity of both game and non-game animals. Examples of game animals would be turkey and white-tailed deer. Examples of non-game animals are in the form of songbirds and herpetofuana. Recently, natural resource managers have become interested in non-game species. Many of the species are facing global declines increasing their importance biologically and economically to managers. When extra steps are taken to make habitat suitable for both game and rare non-game species, opportunities for funding eligibility and management programs open up. Earlier studies have examined the effects of clear cutting prescriptions on herpetofaunal communities. In the Talladega National Forest, prescribed burns are conducted in different regimes to cater to needs of different wildlife species. A burn regime is the term used to describe characteristics of burn prescriptions. An example of this is the use of a 1-3 year burn cycle in the quail habitat. Quail habitat consists of with game species being the target of interest in mind when preparing for a prescribed burn, interest of biologists arises when considering non game species. Jacksonville State University and the United States Forest Service are collaborating on a project examining the effects of prescribed fire regimes on herpetofaunal communities in the Shoal Creek district of the Talladega National Forest.

P147 - The Effects of Kudzu (*Pueraria montana* var. *lobato*) on plant community diversity

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Invasive species have well-documented negative effects on native communities, but trajectories of community recovery after the removal of invaders are still relatively poorly understoodKudzu, *Pueraria montana var. lobata* (Fabaceae) (Willd.), a leguminous invasive vine, has spread throughout the southeastern United States, overgrowing and eliminating native vegetation, primarily through shading. To understand the impacts of *P. montana* on forest communities in northern Mississippi I quantified vegetation on actively infested, control, and removal sites of varying ages. I compared species richness, herbaceous cover, and abundance of woody seedlings and saplings on infested and control sites to determine how *P. montana* affected native plant communities. I also compared vegetation on removal sites to determine how long these effects last and whether community composition approaches that of pre-infested sites over time. Preliminary results show that species richness of woody and herbaceous species and herbaceous cover were significantly reduced by *P. montana* infestation. Abundance of woody seedlings and saplings was not significantly different between infested and control sites. After removal of kudzu, species richness of herbs initially rebounded but declined over time, due to subsequent infestation of the herbaceous weedy species, *Echinochloa crus-galli* and *Lolium perenne*. This study shows the plant communities previously

invade by *P. montana* do not revert back to a pre-invade state but, consistent with Invasional Meltdown theory, reach an alternative state where other invasive species can dominate the community.

P148 - Potential Effects of Declining Coarse Woody Debris on East Coast US Forests

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Faster return cycles due to changing climate and a push toward whole tree harvesting (WTH) from the biofuel industry have led to a decrease in coarse woody debris (CWD) in East Coast forest systems. CWD plays an important role in forest systems by cycling carbon and nutrients back into the soil. To better understand the ecological impacts of decreased CWD in East Coast forests, this study looked at the effect it had on microbial biomass. It is thought that more robust microbial biomass leads to increased rates of nutrient cycling in the soil, thus it is important to understand the effects that decreased CWD will have on microbial biomass. Soil was sampled from plots with high amounts of CWD and plots with no CWD. Microbial biomass was measured, along with percent soil carbon and texture. The data was analyzed by using a linear mixed-effect model. The analysis determined that there was no significant short term response of microbial biomass to decreased CWD, as it produced a p-value of 0.38. However, there was a strong correlation between microbial biomass and percent soil carbon which produced a p-value of 4.52e-08 and an r2 of .96. The results from this study are discussed in an ecological and management oriented context; they indicate that to maintain a healthy microbial biomass, soil carbon concentrations must be maintained. Due to warming temperatures, decomposition rates are predicted to rise, which will lead to an increased loss of CO2 from the soil. Warming temperatures enhance the need for forest management practices that limit WTH and focus on conserving soil carbon in order to maintain a healthy microbial biomass and nutrient cycling in East Coast forest systems.

P149 - Microtopographic control of cliff-face vegetational communities in the Amphibolite Mountain Macrosite

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Cliffs systems can harbor unique, diverse communities such as glacial relicts and endangered biota. However, cliffs are often inaccessible and therefore widely understudied. It remains largely unknown how abiotic factors such as surface heterogeneity, slope, and rock type interact to drive variation in cliff-face vegetation communities. Current field methods are inconsistent among studies, but structure-from-motion techniques may provide an alternative method to quantify spatial variability. We present preliminary results using novel methods on a small cliff system at the Robert Gilly Research Station (Todd, NC). Preliminary results indicate that developing 3D point clouds for vertical cliff plots is possible, but calculations to quantify surface heterogeneity may require further development. In situ measurements of abundance and size of cracks, ledges, and pockets are required to determine accuracy of modeling. The methods developed here will be applied to larger, more extensive cliff systems of the diverse amphibolite mountain system in western NC. Amphibolite mountains have unique plant communities, high species diversity, and many endemic species, but no floristic study of cliff face communities have been completed. Cliffs will be surveyed using two methodological approaches. The traditional method includes recording vascular plant, bryophyte, and lichen species presence on features (ledges, cracks, pockets), local factors, soil volume, and fine scale physical variables. The novel method includes taking overlapping photos of each survey plot, creating point clouds, and quantifying surface heterogeneity. The interactive abiotic influence on the organization of cliff-face vegetational communities will be calculated using both approaches. Finally, we will determine accuracy of surface heterogenicity measurements between traditional and structure-from-motion techniques. Remote sensing techniques may provide a less intrusive and more accessible sampling method. Furthermore, consistency in field methods among studies could allow an increased understanding of how abiotic factors influences cliff-dwelling species distribution.

P150 - *E. coli* in Wheeling Creek

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Escherichia coli (*E. coli)*is a bacterium found in the lower intestines of warm-blooded animals. The presence of *E. coli*in streams can indicate that feces from humans or other warm-blooded animals is present and cause water to become cloudy with an unpleasant odor. High concentrations of *E. coli* are a health concern because *E. coli* is an indicator that pathogenic bacteria and viruses may also be present. The US Environmental Protection Agency sets a maximum safe limit of 151 colony forming units (cfu) for recreational water usage, but concentrations of *E. coli* can change rapidly with environmental conditions. We sought to investigate trends in *E. coli* concentrations in Wheeling Creek, WV (a tributary to the Ohio River) and the Ohio River because both of these rivers are increasingly being utilized for recreational activities. However, old wastewater infrastructures frequently discharge untreated sewage into these waterways, raising health concerns about contact with the stream water. We collected water samples weekly at two sites on the Ohio River, five sites on Wheeling Creek, and three sites on tributaries of Wheeling Creek between September 27, 2018 and December 27, 2018. In total, we collected 128 samples that were analyzed for *E coli* using the IDEXX Colilert System. We have found that the concentrations ranged from 25 to 2,400 colonies of *E. coli,* and only 24 readings (18.8%) were below the EPA safe standard for recreational usage. The Ohio River and tributaries of Wheeling Creek tended to have lower concentrations of *E. coli* than Wheeling Creek itself. As the temperature declined in December *E. coli*concentrations decreased which was likely driven by the bacteria only being able to survive in waters 4°C and warmer.

P151 - Above and below ground impacts of Solenopsis invicta

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Solenopsis invicta, the invasive red imported fire ant, easily spreads to new ecosystems and habitats. Weedy species like fire ants can alter their environments both above and belowground. They are known to form symbiotic relationships with honeydew producing mealybugs that feed on the roots of invasive Bermuda grass. These mealybugs and their plant partners, in combination, aid in colony growth and spread of fire ants by providing optimal carbohydrate and protein nutritional needs. Ants also alter the chemical and physical properties of the soil, creating biodiversity hot spots for microarthropods and microbes. Our study focuses on the impact of fire ants and fire ant removal on biodiversity of microarthropods, microbes, and mutualists in the soil. Boiling water is often recommended as an effective method in eliminating fire ant mounds, with signs of success after just 2 applications. This method is valuable for ecological studies because one can test the before and after effects of fire ants on their communities. Little is known about what this removal method might do to the non-target soil flora and fauna, however. In this study, we selected 50 fire ant mounds located in an acre plot, to sample for microbes, microarthropods, and mutualists. We collected soil samples from inside and outside of the colonies before and after boiling water treatment. We measured soil respiration, microbial community diversity, sampled mealybug mutualists, and extracted microarthropods with Berlese funnels. Looking at the microbial communities and symbiotic plant and insect interactions fire ants form will give insight on how this species is able to spread to new ecosystems, their effects on the soil community, and how to potentially eliminate them without harm to sensitive belowground systems.

P152 - Avian species assemblages within Bursera simaruba live fences in Panama: 15 years of secondary succession

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Tropical dry forests are highly threatened ecosystems. Unlike tropical rainforests, dry forests are easily burned and cleared to be used for farming and livestock. Those remaining are a mosaic of land cover types including old growth forest, secondary forest, riparian forest fragments, pastures, and plantations. Past land-use practices include using live fences to fence in cattle, many of which utilize fruiting tree species. Frugivorous bird species act as seed dispersers for fruiting trees and enhance

forest regeneration in previously cultivated pastures. A previous study in 2003 quantified bird abundance in an early successional dry tropical forest on the Azuero Peninsula of Panama across three habitat types. Bird counts were found to be highest in *Bursera simaruba* trees within live fences with 24 species recorded foraging on the small, fleshy fruit in the middle of the dry season (March). As a follow-up study after 15 years of succession, we aim to quantify bird species richness and abundance within the same live fence with *Bursera simaruba* as the focus tree. We will follow the methodology used in 2003, observing birds for five consecutive mornings in March. We will collect data on the abundance of different bird species foraging on *B. simaruba* from sunrise to 9:00 AM in five 30 minute periods. We predict that bird species richness will be significantly greater after 15 years of succession with a higher percentage of specialist species.

P153 - Urbanization & Bird Biodiversity in the Southeastern United States over a 10 Year Period

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Urbanization is an increase in the number of people that live in relatively small areas and can cause drastic changes in land use. For example, more cement and concrete may be used to accommodate the growing population of people moving to a city. This research analyzes how urbanization affects bird biodiversity in the southeast United States. Biodiversity is the variety and diversity of plants and animals in an environment. Publicly available citizen science bird sighting data in Alabama, Tennessee, Florida and Georgia were used to evaluate bird biodiversity by pinpointing localities that were sampled at the beginning and end of a 10-year time span. Urbanization within these sites was assessed using QGIS and USGS LandSat data from 2001 and 2011. The percentage of impervious cover was calculated for each time point and the change in impervious cover was calculated over a ten year period. We predicted that areas with increased urbanization over the 10 year time span would have a decrease in bird biodiversity, though other patterns in changes in biodiversity may be expected.

P154 - Soil chelating agents used in lead (Pb) phytoextraction by switchgrass

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Chemically enhanced phytoextraction of Pb-contaminated soil typically begins by soil chelation. The chelate EDTA (ethylenediamintetraacetic acid) is regarded as a highly effective Pb-chelate, though its long soil persistence is of concern. Other chelates such as NTA (nitrilotriacetic acid) have much shorter half-life in the soil but might not be as effective. The effectiveness of different chelating agents (EDTA, NTA and NTA+APG) was tested for Pb phytoextraction by native switchgrass (*Panicum virgatum*). First, EDTA (1mM) and NTA (1mM) were evaluated. In addition, NTA was evaluated at multiple concentrations (1mM, 2mM and 5 mM) and NTA (1mM) + APG (alkyl polyglucoside) (1mM). Soil (about 2500 ppm Pb) from a former Superfund site (Cedertown, GA) was used to fill Grow-tubes (300 ml). Plants were grown under controlled environmental conditions in the Science Greenhouse in Kennesaw, GA. Plants were given three times a week a complete nutrient solution (50 mL). Once the plants had been growing for 64 days the soil fungicide propiconazole (2 mg L^{-1}) (trade name Infuse®) was applied (50 ml) to suppress symbiotic arbuscular mycorrhizal fungi (AMF). Eleven species of AMF were identified in the soil and roots using the 16S rRNA gene sequencing. The soil chelates were applied one week later. Plants were harvested as soon as Pb toxic effect was observed. Dried plant tissues were acid digested (HCl and HNO_3) and refluxed at 95°C in an Environmental Express® HotBlock system. The acid digested plant samples were analyzed using a Varian SpectraAA 220 FAAS. While both EDTA and NTA exhibited increased Pb accumulation compared to the Control plants, the EDTA treatment showed significantly and much higher Pb concentrations in shoot tissues. Plants receiving 5 mM had 40% less biomass than plants receiving 1mM NTA. Plants receiving 5 mM NTA and 1mM NTA + A showed clear signs of Pb-toxicity (chlorosis).

P155 - A Method for Quantifying Herbivory Using Open-Source Programming

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Herbivory is one of the most important animal-plant interactions found in nature, yet the task of quantifying herbivore damage statistically is challenging, and requires sacrificing one or more of the following: precision, accuracy, time, and cost. Different studies implement different methodologies for quantifying leaf area lost due to herbivory. Typically a researcher would choose between either visual or digital methods. Visual methods involve a trained and experienced researcher simply estimating how much leaf area was lost based on their expertise, or using transparent grid paper to trace leaves and obtain an area statistic, which still leads to an estimation of the size of an unaltered leaf. Both of these methods are subjective and not reliably repeatable. Digital methods include using commercially sold portable leaf area meters, which are expensive and therefore not attainable for all research groups, or using a standard flatbed scanner combined with software such as Adobe Photoshop, ImageJ, Scion, etc. Studies employing the latter technique have identified inaccuracies involving herbivory on leaf margins and sometimes researchers still have to trace leaves and estimate the "original leaf" size or shape. This is shown to be imprecise and time-consuming as well. This study describes the development of a method for quantifying herbivory that is free, quick, easy to use, and precise. The new technique is implemented by scanning the leaves with a flatbed scanner, running them through a python application that measures the area of each leaf, as well as the area of a template (made in an open-source photo-editing program) made to fit that leaf's size and proportions, then outputting the two data points for each leaf in an Excel spreadsheet. Additionally, the previously mentioned methods were executed and then compared to determine the method with the greatest precision, accuracy, and cost/time-effectiveness.

P156 - Assessing patterns of plant richness and terrestrial productivity in Great Smoky Mountains National Park using data from the National Ecological Observatory Network (NEON)

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The relationship between biodiversity and productivity is complex, scale-dependent, and varies by environmental context. Human activities, such as land use and climate change, are predicted to have a considerable impact on ecosystem function and productivity. The National Ecological Observatory Network (NEON) is a continental-scale ecological observation facility comprising 81 field sites across the United States that characterizes and quantifies how our nation's ecosystems are changing. At the site located in Great Smoky Mountains National Park (GRSM), NEON established 20 x 20 m plots throughout the park in 2015 and documented presence of plant species annually. We downloaded the plant presence and percent cover dataset for GRSM for 2015-2017 from the NEON data portal. We calculated plant species and generic richness for 30 plots (23 deciduous forest, 7 evergreen forest) in 2015 and 33 plots (26 deciduous forest, 7 evergreen forest) in 2016 and 2017. We also downloaded terrestrial primary production data (i.e., annual NPP) from the Numerical Terradynamic Simulation Group. These data products were created using Landsat satellite imagery and meteorological data. Across all plots in GRSM, NPP was not related to species or generic richness in any year. In all years, species and generic richness were higher in deciduous forest than in evergreen forest plots; NPP was higher in deciduous forest plots than in evergreen forest plots in 2015 and 2017, but not in 2016. The similarity in NPP between forest types in 2016 could be due to the severe drought that year having a larger effect on deciduous than evergreen species. NPP was higher in forests on inceptisols than ultisols, but there was no relationship between species richness and NPP for either soil type. Future analyses will examine relationships between NPP, species and generic richness, and climate, and will utilize NEON's woody vegetation plant structure dataset as well.

P157 - Phenology, Pollination, and Seed Dispersal Syndromes in Reforested Dry Tropical Ecosystems

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Dry tropical forests are one of the most endangered ecosystems. Pollination and seed dispersal syndromes are strong drivers of forest recovery. Animal pollination dominates tropical forests while animal seed dispersal can represent 50% of tree species in dry tropical forests. In dry tropical forests, a pronounced dry season can result in harsh conditions for both plants and animals. Many animals hibernate or migrate to wetter areas. However, the dry season is also a time of abundant flowers and fruit, both of which are important resources for animal pollinators and seed dispersers. Diversity and abundance of flowers and fruit in the dry season may vary within dry tropical forests of different successional ages and management regimes. In Panama, most of the original extent of dry tropical forest is gone. Remnants, serving as sources for propagules, animal pollinators and seed dispersers, persist in more remote locations. Over the last 30 years, reforestation has become a popular strategy to reclaim degraded pastureland. Common reforestation strategies include planting teak in monocultures, planting native timber species or relying on natural regeneration. However, little is known about the effect these different strategies have on biodiversity. During the dry season (March 2019), surveys will be conducted in three reforestation types (all 15 years old) as well as within old secondary forest. All flora (canopy and understory) will be identified and recorded as having flowers, fruit, or both. Four random transects will be set up in each of the four forest types. Any visitations by insect or bird pollinators will also be recorded. The prediction is that 15 year secondary forests will have the greatest number of species and individuals in flower and fruit while teak plantations will have the least. This is predicted to be positively correlated with bird and insect richness (quantified in two parallel studies).

P158 - An Assessment of Compositional Shifts in Mississippi Forests: Two Centuries of Change in the Woody Taxa Comprising Forests of Forrest County, MS

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Public Land Survey System (PLSS) records provide some of the earliest quantitative and qualitative data on the composition of forests through its records of the woody taxa present prior to extensive European settlement. These data can be used to reconstruct forests and model characteristics of past vegetation providing a baseline of conditions which can be used to assess how the composition of forests have changed over time, specifically by comparing them to the composition of modern forests using Forest Inventory and Analysis (FIA) program data. As a pilot study to assess compositional changes in the forests of Mississippi, PLSS and FIA data for Forrest County, MS were obtained. I hypothesized that the composition of woody taxa comprising pre-settlement forests would differ from modern forest. Analysis of Similarity (ANOSIM) revealed significant dissimilarity between historic and modern forests of Forrest County ($R=0.687$, $p<0.001$), supporting the hypothesis. Because common names rather than scientific names were recorded in PLSS records, it is difficult to identify the taxa mostly influencing these changes. However, an assessment of relative abundance showed a nearly 40% reduction of *Pinus* spp. in modern forests compared to historic forests which is likely attributed to the reduction in *Pinus palustris*, historically the monodominant species of the study area. Shannon diversity index, species richness, and species evenness were found to be greater in modern forests than historic forests also indicating a shift in the composition of woody taxa comprising Forrest County forests over the past two centuries.

P159 - Leaf spectra as indicators of Beech Bark Disease

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The forests of North America are increasingly under pressure from invasive pathogens that cause substantial ecosystem destruction, service losses, economic market decline, and species loss. The American beech tree has been under threat from Beech Bark Disease (BBD), a two-stage invasive forest pathogen complex for the past 130 years. Here we employed leaf spectroscopy to determine BBD infection status. Full-spectrum leaf reflectance data (400-2,500nm) were collected from 281 trees in Elk Knob State Park that were also scored for BBD infection status ranging from 0 (no infection present) to 4 (presence of pathogen fruiting bodies). We employed partial least squares discriminatory analysis to determine if leaf spectra were related to infection status. Our preliminary results indicate that leaf spectra perform well at discerning BBD infection status with ~80% accuracy. Future work will focus on attempting to differentiate stress induced by BBD from other environmental

stressors such as drought and nutrient limitation. Spectral methods for detecting BBD infection could be incorporated into remote sensing platforms to enable BBD assessment over large spatial scales.

P160 - Detection and Identification of Arbuscular Mycorrhizal Fungi in Two Riparian Tree Species Using AML1 and AML2 PCR Primers

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Riparian vegetation functions in the regeneration of ground water sources, in the removal of excess nutrients and sediments from surface runoff, and in maintaining favorable environmental conditions for life in this system. This research forms part of a larger project investigating the feasibility of using American Sycamore (*Platanus occidentalis* L.) in addition to Black Willow (*Salix nigra* Marshall) in restoration of riparian areas, and looking at the relative importance of arbuscular mycorrhizal fungi (AMF) in the wellbeing of these plants. Preliminary studies in our lab insinuated possible variations in the benefits of the mutualistic association between these tree species and their fungal affiliates. However, specific AMF were not identified. We hypothesize that mycorrhizae will not differ among tree roots of the different tree species and that both riparian trees will be colonized by the same AMF types. In this research, our purpose was to compare two methods of DNA extraction from the root samples of each species and use the DNA to identify AMF. One method of DNA extraction was an adjusted protocol for extracting DNA from plant samples while the second method involved the use of the DNeasy Powersoil Kit (Qiagen). For the identification of AMF after DNA extraction, we targeted the small subunit of rRNA genes using AML1 and AML2 primers to amplify and distinguish among subgroups of *Glomeromycota* fungi. The results for the plant protocol showed no presence of DNA, except for our control group, whereas the soil kit protocol was successful for all samples. The next step in our research is to repeat the DNA extraction using only the soil kit protocol, identify potential contamination (as DNA was identified in the control), associate plant DNA from the root samples to our riparian tree species, and distinguish different types of AMF from the division *Glomeromycota*

P161 - Foliar Salicylic Acid Application improves phytoextraction of Switchgrass Grown in Lead Contaminated Soil

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Soil lead contamination represents a major environmental and public health risk. Soil remediation includes phytoextraction (using plants to remove pollutants) which is positive for the environment. Chemically induced phytoextraction improves the efficiency of this soil remediation technique. Switchgrass seeds were germinated and the seedlings were transplanted, into plastic grow-tubes (300 ml) that were filled with Pb-contaminated soil (about 2500 ppm) obtained from a former Superfund site in Cedartown, Georgia. Plants were grown under controlled conditions in the Science Greenhouse at Kennesaw State University, Kennesaw, GA. Plants were given twice a week 50 ml of a complete nutrient solution. The foliar salicylic acid-treatment started 63 days after planting. Approximately 0.30 mL of a 150 ppm aqueous solution of salicylic acid was sprayed onto the leaves of each of the plants in the "foliar salicylic acid-treatment". The salicylic acid solution was applied to the appropriate plants twice a week until harvest. Once the plants had been growing for 70 days the soil fungicide propiconazole (2 mg L^{-1}) (trade name Infuse®) was applied (50 ml) to suppress symbiotic arbuscular mycorrhizal fungi (AMF). Eleven species of AMF were identified in the soil and roots using the 16S rRNA gene sequencing. The soil chelate NTA (nitrilotriacetic acid) was applied (50 mL of a 1 mM solution), 77 days after planting. The application of NTA was continued twice a week until harvest, along with the ongoing foliar salicylic acid foliar application to the appropriate plants. All plants were harvested 106 days after planting. Dried plant tissues were acid digested (HCl and HNO_3) and refluxed at 95°C in an Environmental Express® HotBlock system. The acid digested plant samples were analyzed using a Varian SpectraAA 220 FAAS. Plants receiving foliar application of salicylic acid were significantly heavier than control plants.

P162 - Phytoextraction of Lead Contaminated Soil via Switchgrass Enhanced by Foliar Iron Application

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Lead (Pb) soil contamination exhibits detrimental effects upon biological systems. Lead is toxic to humans and other organisms in minuscule amounts. Soil remediation includes phytoextraction, the use of plants to remove toxic elements from the environment. High soil pH resulting from chelate application may result in impaired ability of plants to obtain iron (Fe), essential for chlorophyll functioning. It is therefore predicted that Fe foliar application might solve this problem. Switchgrass seeds were germinated and seedlings were transplanted into plastic grow-tubes (300 mL) filled with Pb-contaminated soil (about 2500 ppm) from a former Superfund site in Cedartown, Georgia. Plants were grown under controlled environmental conditions in the Science Greenhouse at Kennesaw State University, Kennesaw, GA. Plants were given 50 mL of a complete nutrient solution twice a week. The foliar Fe-treatment started 50 days after planting. Approximately 0.30 mL of a 20 ppm aqueous solution of iron sulfate (FeSO4×H2O) was sprayed onto the leaves of each designated plant. The Fe solution was then applied to the appropriate plants twice a week until harvest, with the continued nutrient solution application. 55 days after planting, plants were given 50 mL of the soil fungicide, propiconazole (2 mg L^{-1}) (trade name Infuse®), to suppress symbiotic arbuscular mycorrhizal fungi (AMF). Eleven species of AMF were identified in the soil and roots using the 16S rRNA gene sequencing. The soil chelate, NTA (nitrilotriacetic acid), was applied (50 mL of a 1 mM solution) 62 days after planting. NTA application was continued twice a week until harvest, with the ongoing foliar-Fe spray to the appropriate plants. All plants were harvested 78 days after planting. Dried plant tissues were acid digested (HCl and HNO_3) and refluxed at 95°C in an Environmental Express® HotBlock system. The acid digested plant samples were analyzed using a Varian SpectraAA 220 FAAS.

P163 - The confluence of disjunct plant species in a remarkable Eastern Highland Rim seepage grassland, Putnam County, Tennessee

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A diverse array of plant species was found in a recently discovered Eastern Highland Rim acidic seepage prairie in Putnam County, Tennessee. This site constitutes only one of two localities known to support this community worldwide, with both summing less than three acres. Historically these communities occurred as small-patch, low-competition environments within a broader prairie-savanna matrix. Located in the Eastern Highland Rim section of the Interior Plateau physiographic province, this perennial seepage wetland has little surface flow and strongly acidic soils. Biogeographic patterns of over 110 vouchered species collected from the site are assessed, and summary statistics are reported from sixteen 1 m^2 quadrats systematically sampled during the 2018 field season. Approximately 18 species reported from the site represent county records, four of which are state endangered. Two additional species are possibly new records for Tennessee: *Xyris curtissii* and *Diodia harperi*, both disjunct from the Coastal Plain. Southeastern Coastal Plain disjunct species were notably rich at this site, a pattern already well-documented for Eastern Highland Rim wetlands. Northern, northeastern coastal plain, midwestern, and scattered species also occurred as disjuncts, however, suggesting the use of this site as a refugium during multiple climatic events.

P164 - Using remote cameras to assess the diversity of avian frugivores that use oak mistletoe (*Phoradendron leucarpum*) in forested wetlands of southeastern Virginia and northeastern North Carolina

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The oak mistletoe (*Phoradendron leucarpum*) is a stem parasite found across the southern United States (US) that is dependent on avian frugivores for seed dispersal. In general, mistletoes can be considered keystone resources, with removal experiments showing disproportionate effects to avian communities. Mechanisms driving observed oak mistletoe habitat relationships are unclear, and we

will use similarities in estimated habitat relationships of this mistletoe and its avian dispersers to infer the role of frugivores in determining mistletoe distribution. The cedar waxwing (*Bombycilla cedrorum*) and eastern bluebird (*Sialia sialis*) are assumed to be the primary dispersers of mistletoe seeds in the southeastern US; anecdotal evidence suggests additional avian species eat mistletoe fruits. In winters (Dec-Mar) 2017-2019 up to seven remote cameras were deployed at sites in southeastern Virginia and northeastern North Carolina to capture visits to fruiting oak mistletoe by avian frugivores. Mistletoe frugivores documented using this method included cedar waxwing, eastern bluebird, raccoon (*Procyon lotor*), and eastern gray squirrel (*Sciurus carolinensis*). Results from this effort will help us select focal avian frugivore species from presence-absence survey data for an occupancy analysis.

P165 - Bird Diversity and Abundance in Urban Greenways

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Urban areas are increasing in size throughout the world, removing habitat for wildlife. The construction of urban greenways creates places of recreation for humans and potentially wildlife habitat, but the effects on wildlife vary from place to place. The city of Asheville, NC, has plans to extend its greenway system, connecting the north and south greenways together. This study is designed to determine how the greenway system affects wildlife, using the indicator species of birds as the focus. We performed vegetation surveys and measured bird species richness, diversity, and abundance across three different sites in Asheville, NC: an already established greenway site, a proposed greenway site, and a control street site. Along each site, we placed five points 200 m apart where we performed 10-minute fixed-radius point counts during May, June and July, 2018. We repeated these surveys five times, recording all bird species seen and heard, placing them into different distance classes and time intervals to better estimate abundance. For the vegetation surveys, at each point of each site we estimated the percent of invasive and viney vegetation in 5 height strata. The established greenway had more open tree and shrub cover than the unestablished greenway, while the unestablished greenway had significantly more invasive shrub and vine cover. The established greenway had a higher species richness, diversity and abundance than the un-established future greenway site, and both had more diversity and abundance than the city street site. This study is in line with other studies that show the importance of greenways and green spaces in urban areas to help promote biodiversity.

P166 - Effects of Fire Severity and Urbanization on Plant Communities in the Great Smoky Mountain National Park

Mali Hubert, Monica Papeş

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Fire is one of the most powerful disturbances of natural ecosystems because it can reshape communities. In the southern Appalachian region of the United States, fires are a re-emerging, yet still largely historical dimension of the landscape. While many aspects of wildfire effects have been elucidated in the western United States, effects of wildfire in the eastern United States remain unclear. Wildfire disturbances in the southern Appalachians are considered rare, so opportunities to study fire effects are limited and gaps exist in our knowledge of the ecological outcomes of large wildfires in the region. We are investigating understory plant communities affected by the 2016 Chimney Tops 2 fire at 20 plot sites in Gatlinburg, Tennessee, and in the Great Smoky Mountain National Park. Our goal is to determine vegetation successional stages as the landscape recovers from fire, as well as the susceptibility of site locations to species dominance over time. In 2017, plant species richness and abundance varied throughout the twenty plot sites examined in Gatlinburg and the Great Smoky Mountain National Park. We observed highest plant abundance at no burn and natural sites and lowest abundance at high burn sites. In addition, abundance at the natural sites was 1.5 times higher than at the urban sites. The most diverse was the low/medium burn sites, followed by no burn, high burn, and reference. Continuation of this study will determine if disturbance across the urban and fire gradient generates new patterns of species dominance over time and whether those species will create new communities within disturbed locations. The data collected from this study (plant species richness and abundance) will help to establish how the plant communities in southern Appalachian Mountains respond to fire events in the face of a warming planet where wildfires are becoming an increasing occurrence.

P167 - Small mammal and invertebrate diversity on a suburban campus: A comparison of four microhabitats

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Invertebrates and small mammals, although rarely seen, play important roles in ecosystems; they are seed dispersers and critical members of the food chain as prey for larger and more conspicuous animals. Here we present preliminary findings on the diversity of small mammals and invertebrates on the campus of Georgia Gwinnett College. Although located in the Piedmont ecoregion of North Georgia, the area is an increasingly-developed suburb of Atlanta. To collect small mammals, a grid of 100 Sherman small mammal traps were baited with apple and peanut butter-oat bait balls and set for four nights. Mammals were marked with eartags. Invertebrates were collected using pitfall traps and Berlese funnels in the same grid in a subsequent week. The grid encompassed four 'microhabitats': lawn, "wild" herbaceous growth, kudzu overgrowth, and a slope of mixed lawn and mowed kudzu. The data were analyzed to determine if there were any significant differences in the animals collected between these four habitats. Mammals trapped included house mice and hispid cotton rats, most of which were caught in the "wild" herbaceous growth. Fewer animals were captured in the mowed lawn. Invertebrates consisted mostly of millipedes, which were distributed in all microhabitats. Collembolans were more common in the non-mown areas.

P168 - Some like it cold: snow algae are major drivers of archaeal, bacterial, and fungal communities in snow

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Despite harsh environmental conditions associated with life in late-season alpine snows, such as poor nutrient availability, minimal liquid water availability, and strong solar irradiation, microbial life can thrive. Late season snows are often colonized by psychrophilic snow algae (*Chlamydomonas* cf. *nivalis*) which can form visually stunning blooms during the growing season. Previous work has shown these algae also facilitate heterotrophic community formation. To investigate how snow algae structure microbial communities, we utilized community sequencing of algae, fungi, bacteria, and archaea (Illumina MiSeq) coupled with nutrient and physicochemical measurements. Snows were sampled at the continental scale (Washington, Colorado, and Wyoming) by collecting surface snows from within the center of algal blooms (maximum algal biomass), the periphery of blooms, and from uncolonized snows adjacent to the bloom. Samples were used to test hypotheses on cross-domain co-occurrence, syntrophic relationships, and algal facilitation. Results indicate a complex network of microbial interactions whereby microbial communities are structured locally by algae and regionally by biogeographical attributes. Further, diversity estimators suggest microbial community diversity is tightly linked with algal biomass. Snow communities are dynamic and diverse and are proving to be a reservoir of novel and insofar undescribed biodiversity. Continuing investigations on algal genetic diversity and nival communities promise to reveal much about snow microbial ecology.

P169 - Chlamydomonas reinhardtii mutant cc6-1, is cytochrome c biogenesis deficient

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The *Chlamydomonas reinhardtii* mutant *ccs6-1,* has been shown to be deficient in plastid cytochrome *c* synthesis (ccs). Cytochromes *c* are defined by the covalent attachment of a heme molecule and are involved in the electron transport chains of both photosynthesis and cellular respiration. Previous work with the *ccs6-1* mutant has identified a molecular lesion in the*Cre12.g485850* gene, which encodes a protein in the FAM210B family. Fam210b proteins are conserved from green algae to humans, are found in both the mitochondria and chloroplast, and the primary domain in these proteins is a domain of unknown function. Here we show results from a complementation analysis after transformation of the *ccs6-1* mutant with a FLAG-tagged cDNA construct of the *Chlamydomonas* gene *Cre12.g485850.*

P170 - How Cellular Metabolic State and the Chaperone Protein Hsp104 Interact to Affect the Spontaneous Formation of the Yeast Prion [URE3]

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Prions are transmissible misfolded, pathogenic proteins that can induce abnormal folding of the properly folded versions of themselves. Prions are a problem because they produce chain reactions that propagate themselves in large numbers, they are hard to completely eradicate, and they cause neurodegeneration. Understanding the formation of prions in yeast should lead to understanding how this also occurs in mammals. My overall aim is to determine how cellular metabolic state can influence spontaneous prion formation rates in baker's yeast (*Saccharomyces cerevisiae*) with or without the Hsp104 chaperone protein present. Previous research has shown that the removing the HSP104 gene can eliminate the [URE3] prion, "curing" infected cells. Using a prion-selective medium we measured rates at which prions spontaneously formed at different phases of cell growth and then compare them to one another, and to the spontaneous formation rates in a strain of yeast that is lacking the HSP104 gene. At certain phases of growth, such as saturation phase, lacking the HSP104 gene had higher rates of spontaneous prion formation than with the gene, suggesting that while the Hsp104 protein aids prion propagation, once the [URE3] prion is present, it also prevents spontaneous [URE3] prion formation.

P171 - The Effects of Lipopolysaccharide and Peptidoglycan on Progesterone Receptor Expression in HeLa Cells:

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In these experiments we investigated progesterone receptor expression (P4-R) dynamics in HeLa cells in the presence and absence of two inflammatory mediators – lipopolysaccharide (LPS) and peptidoglycan (PGN). Initially, HeLa cells were incubated in serial dilutions of FITC-P4 (10 – 100 nm) to determine receptor expression as well as receptor density. To ascertain the effect of an inflammatory insult, HeLa cells were incubated in either LPS (2, 20, 200 ng/ml) or PGN (10, 50, 100 uM) - all analyses were performed via flow cytometry. Our results indicate that 1) HeLa cells express the P4-R on the plasma membrane and bind progesterone (P4) with high affinity and saturability and 2) that incubation in both LPS and PGN results in an upregulation of receptor expression in a concentration-dependent manner as compared to controls. These results are promising for further investigations into the unique anti-inflammatory properties of P4 in HeLa cells.

P173 - Differential Roles of EDNRB Isoforms in Breast Cancer Cell Lines

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Breast cancer remains the most prevalent type of cancer diagnosed in women living in the United States. While much progress has been made characterizing key proteins driving many breast cancers, some forms of breast cancer remain largely resistant to treatment. The endothelin axis regulates the progression of numerous cancers and consists of G-protein coupled receptors (GPCRs), endothelin A receptor (EDNRA), endothelin B receptor (EDNRB), and its protein ligands ET1, ET2, and ET3. While many of these proteins have been fully characterized in breast cancer, the specific contribution of EDNRB to breast cancer progression is unclear. This study focuses on EDNRB and the differences between three of its major isoforms (201, 202, and 204) in order to understand more about its role in cancer proliferation through downstream signaling. We measured the activation of AKT and ERK due to their well-known and important roles in cell survival and invasion. We transfected plasmids encoding for EDNRB-201, 202, and 204 into triple negative MDA-MB-231 human breast cancer cell lines and performed Western Blots to analyze expression and activation of AKT1 and AKT2 at Serine 473, AKT1/2/3 at Threonine 308, and ERK. Additionally, we conducted MTT assays to analyze the cells' proliferation activity in response to the EDNRB isoforms. Our results showed that EDNRB-204 significantly increased pERK activation, and EDNRB-201 significantly increased pAKT1 activation over empty vector while the other isoforms showed no significant alterations in these proteins. Phosphorylation of AKT2, however, was not significantly changed with any of the isoforms when compared to empty vector. The proliferation results showed

that by day 3, EDNRB-202 significantly increased proliferation of breast cancer cell lines, but EDNRB-201 and EDNRB-204 did not. Therefore, our findings suggest differential roles for EDNRB isoforms in breast cancer cells.

P174 - Novel Pyridazine Compounds as Adrenergic Receptor Agonists

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Epinephrine, also known as adrenaline, is one of the most important neurotransmitters in organisms possessing a sophisticated central nervous system. As a medication, epinephrine is used to treat a number of conditions including anaphylaxis, cardiac arrest and superficial bleeding. For individuals with life threatening anaphylactic conditions, epinephrine costs can be daunting. An increase in viable epinephrine alternatives into the marketplace of these drugs can be a lifeline to individuals suffering from these diseases. The objective of this study is to identify novel molecules that would mimic epinephrine effects *in vivo* using the zebrafish melanosome assay. Our preclinical data has identified Pyridazine based molecules as potential epinephrine analogs based on the altered melanosome movement observed in zebrafish assays. Epinephrine binds to A2-adrenergic receptors causing melanosome aggregation. Pyridazine molecules cause similar melanosome aggregation, however the downstream processes governing the Pyridazine induced cellular responses are unclear. We hypothesize that Pyridazine binds to adrenergic receptors to induce changes in intracellular cyclic AMP and Protein Kinase activity that affects Myosin Motor proteins, and that these affects can be analyzed based on the activity of Zebrafish Melanosome trafficking. Due to the low amount of toxicological effects observed and the high specificity of these drugs, we are hopeful that the compounds could serve as useful epinephrine alternatives in the future.

P175 - Pyridazine Compounds as Novel Anti-Cancer Therapeutics

Favour Ukpongson

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Prostate Cancer, after skin cancer, is the most common cancer in American men and the second leading cause of cancer death in American men, behind lung cancer. To combat cancer, novel ideas are continually discovered such as pyridazine based chemical compounds which can be tested to determine their anti-cancer properties. However, the search for a drug that will kill the cancer cells without having negative side effects on the patient still continues. To test the efficacy of these pyridazine based compounds, cancer cells from the PC3 cell line are injected into a model organism, for this purpose, Danio rerio commonly known as Zebrafish. This model organism provides an in vivo environment relatively similar to that of humans hence its use in this experiment. Zebrafish make in vivo imaging of the cancer cells and chemical screening of the compound easy. Pyridazine is a Nitrogen-containing heterocycle and aromatic compound. As observed in other ongoing cancer research, the pyridazine moiety is an important structural feature of various pharmacological active compounds. The pyridazine compounds would be tested to see which one kills the most cancer cells while causing little to no damage to healthy somatic cells in the Zebrafish. We hope to find a more effective anti-cancer drug which will be derived from these pyridazine based compounds so that the mortality rates caused by cancer can be greatly diminished. Finding an anti-cancer drug will slow metastasis of cancer cells and provide a better treatment plan to patients where they experience little to no side effects unlike other treatment plans like chemotherapy that eventually leads to hair loss etc.

P176 - Restrictive PCR and Sequence Analysis Suggest Circularization of mRNAs in Human HEK Cell Line Mitochondria

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Circular RNAs are known to occur across the biological spectrum from viruses to vertebrates. Until recently, they had not received much attention but the discovery of their widespread occurrence and abundance in the human cell nucleus has sparked interest in their existence and potential purpose. Vertebrate mitochondrial mRNAs differ from those produced from nuclear genes because they are produced as parts of linear poly-cistronic transcripts that are endonucleolytically cleaved prior to translation. Whether or not these mRNAs are circularized has been ambiguously suggested in one

published study that offered no empirical evidence. The purpose of our project was to look for evidence of circular versions of mitochondrial mRNAs in a human cultured cell line. Mitochondrial mRNAs were isolated from human cell lines and were treated with RNase R leaving behind only circular mRNAs that were present. Using reverse transcriptase, cDNA was produced from the isolated circular transcripts. Strict PCR protocols were designed in order to yield products with the cDNA only if circularization had occurred. The results suggested occurrence of mRNA circularization within each gene in the mitochondrial genome. The resulting DNA products were sequenced and subsequently analyzed bioinformatically. These data provided evidence that circularization had occurred and sites where the 5' and 3' termini of the mRNA strands had been ligated were clearly visible. Further assessment showed that each gene on the mitochondrial chromosome possessed multiple potential ligation sites on their transcripts. Analysis to date has identified that the majority of the ligation sites occurred in the coding region of each gene's transcript, meaning they are incapable of producing functional proteins. This finding suggests that mRNA circularization occurs not as an act of increasing efficacy of translation, but as an intermediate step in mRNA processing or degradation.

P177 - Identifying Markers of the Hybrid Epithelial/Mesenchymal State

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Epithelial to Mesenchymal transition (EMT) is the cellular mechanism by which epithelial cells with tight cell-to-cell adhesion and apical to basal polarity convert into individual and invasive mesenchymal cells. EMT is necessary in developmental processes such as implantation and is reactivated during organ fibrosis and cancer metastasis. Importantly, EMT is reversible through the process of Mesenchymal to Epithelial transition (MET). As cells transition between the epithelial and mesenchymal state, they acquire characteristics of both cell types, gaining a metastable intermediate phenotype. Currently, markers for the epithelial and mesenchymal phenotypes have been well established, but those for the intermediate phenotype remain elusive. Trophoblast stem (TS) cells undergo EMT and differentiate into invasive giant cells, which invade into the mother's uterus establishing placentation. Wild type TS (TS^{WT}) cells maintain characteristics of the epithelial phenotype, whereas TS cells with a Kinase Inactive MAP3K4 (TS^{KI4}) display an intermediate EMT state. We discovered that expression of a key basic helix loop helix (bHLH) transcription factor (TF) is dramatically increased in TS^{KI4} cells when compared to the epithelial TS^{WT} cells. shRNA knockdown of this bHLH TF in TS^{KI4} cells restores the epithelial phenotype, including expression of the epithelial marker *Cldn6* and loss of the mesenchymal marker *Vim*. In addition, reduction of this bHLH TF in TS^{KI4} cells decreases invasiveness, restores barrier formation, and promotes re-localization of the epithelial marker E-cadherin to the plasma membrane. Based on our preliminary data, we predict that this bHLH TF may promote and maintain the intermediate characteristics exhibited by TS^{KI4} cells, serving as a marker for the intermediate EMT phenotype.

P178 - The epithelial stem cell phenotype is controlled by the expression and activity of NF-κB family members

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Cellular phenotypic switching between epithelial and mesenchymal states occurs via a reversible process known as epithelial to mesenchymal transition (EMT). During EMT, the epithelial cells lose cell-cell contact and acquire invasive mesenchymal properties. The EMT program occurs during development and tissue regeneration and is reactivated during organ fibrosis and cancer metastasis. The first developmental EMT occurs in the trophectoderm of the blastocyst where the trophoblast stem (TS) cells differentiate into invasive giant cells establishing implantation. Our goal is to define the transcriptional pathways regulating both normal and pathological EMT during development in stem cells. We use TS cells isolated from wild-type murine blastocysts and mutant TS cells isolated from kinase-inactive MAP3K4 (KI4) mice. Wild-type TS (TS^{WT}) cells are epithelial cells, whereas kinase inactive MAP3K4 TS (TS^{KI4}) cells display an intermediate phenotype, exhibiting both epithelial and mesenchymal characteristics. Recently, we have discovered the altered expression and activity of NF-κB in intermediate TS^{KI4} cells relative to epithelial TS^{WT} cells. Further, the dysregulated expression of NF-κB induces an intermediate phenotype. Importantly, restoration of expression of NF-

κB in intermediate TS^{KI4} cells induces the transition to an epithelial phenotype. Specifically, we observed remodeling of the actin cytoskeleton, converting the filamentous actin in TS^{KI4} cells into cortical bundles. Also, re-expression of NF-κB in TS^{KI4} cells restored the expression and localization of tight junction proteins, including claudin-6 and ZO-1. Importantly, these changes in the cytoskeleton were associated with restoration of epithelial barrier function. Together, these data suggest that the expression and activity of NF-κB are critical for determining the cellular fate of TS cells.

P179 - Modulation of Phagocytic Activity of Alpha-Synuclein Stimulated Microglial cells by Anti-inflammatory agents

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Nicotine has long been thought to be a carcinogen found in tobacco cigarettes and more recently E-cigarettes. Although public consensus shows a negative reception, recent in vivo and in vitro studies have supported the use of nicotine as an anti-inflammatory compound. In particular, its role in Parkinson's disease (PD) patients has been purported to be neuroprotective against PD. This is evidenced by epidemiological studies showing that smokers tend to have a lower incidence of PD. The degeneration of dopamine neurons during PD is concurrent with the release of pro-inflammatory cytokines that cause inflammation in the brain. This can reduce the neuroprotective effects of the microglia, by inhibiting their phagocytic response. With this in mind, we investigated the ability of nicotine and ibuprofen (a non-steroidal anti-inflammatory drug) to stimulate the release of anti-inflammatory cytokines and stabilize the phagocytic activity of microglia in an inflamed environment. We designed our experiment to model a typical PD patient. The BV-2 microglial cell line were first exposed to varying doses of nicotine, ibuprofen then stimulated by alpha-synuclein (α-synuclein). Phagocytic activity was measured using fluorescently-tagged E. coli particles and quantified using Image-J. Our experiments found that nicotine stabilized phagocytic activity in microglia incubated in neurotoxic environments induced by α-synuclein. This supports the utility of anti-inflammatory compounds in the regulation of phagocytosis in microglia and their potential as a mechanism for therapeutic treatments of PD

P180 - Optimization of western blotting for the detection of proteins of different molecular mass

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Western blotting is a common procedure for the detection of specific proteins in a complex biological mixture. Some of the key factors in obtaining optimum protein-specific signal include, type of membrane, blocking agent, and concentration of methanol used in Towbin's Transfer Buffer (TTB). Aim of this study is to obtain optimal signal for proteins of different molecular mass using combination of these variables. Cell lysates were prepared from a lung epithelial cell line (CFBE) and subjected to SDS-PAGE and transferred to either nitrocellulose (NC) or PVDF membrane. Membranes were then blocked with a variety of blocking agents (BSA, gelatin, non-fat dry milk, FBS or their equimolar mixture), and immunoblotted with antibodies against randomly chosen protein markers representing high (CFTR; MW 170 kDa), medium (LAMP1; MW 110 kDa), and low (Rab11; MW 25 kDa) molecular mass proteins. Optimal conditions were identified, and then subjected to another set of experiments to determine the effects of methanol concentration (0-20%) in TTB in maintaining or further enhancing the optimized protein-specific signals. Our data suggests that optimum protein-specific signals can be obtained when NC membrane was used and blocked with a mixture of blocking agents. Presence of methanol in TTB appears to have little to no effects on improving signals of high molecular mass protein. However, in case of medium and small size proteins a lower concentration of methanol (10%) was sufficient to produce optimal signal. Methanol, a toxic solvent, therefore can be removed or reduced from TTB without compromising with the optimized protein-specific signals.

P181 - The Effects of Calcitriol and Seocalcitol on c-Myc, n-Myc, Id2 and p53 in SK-N-SH Neuroblastoma Cells

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This study focused on the effects of calcitriol and its structural analog, seocalcitol, also known as EB1089 when used as treatment on SK-N-SH neuroblastoma cells. This study placed specific focus on the regulatory effects of the proto-oncogenes, n-Myc and c-Myc, the retinoblastoma protein Id2, and the tumor suppressor gene p53. This study contained both chemistry and biology components. The chemistry component of this research focused on identifying the presence of the calcitriol and seocalcitol within the treatment samples that were used on the SK-N-SH neuroblastoma cells. The biology component again used, PCR as well as RT-PCR to analyze the gene expression of n-Myc, c-Myc, Id2, and p53. The conclusion of this study yielded successful detection and confirmation of presence of known functional groups within the calcitriol and seocalcitol organic structures through FTIR. The RT-PCR results displayed both increasing and decreasing effects amongst the c-Myc, n-Myc, Id2 and p53 genes. Future studies will focus on replicating these results so as to provide further validation of trends in expression.

P182 - Quantifying Behaviors in Zebrafish Autism Models

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Autism spectrum disorder (ASD) can be identified by behavioral characteristics like repetitive movements and hypo/hypersensitivity to sensory stimuli. While behaviors of ASD are well known the neurological basis of those behaviors have not yet been identified. Accordingly, we hypothesize that two zebrafish autism models, with *shank3*and *syngap1*mutations, will have distinguishing characteristics in their movements in response to a calibrated vibrational stimulus when compared to a wildtype group. To determine whether zebrafish autism models also had altered behaviors, we used a high-speed camera and a biological tracking software (FLOTE) to analyze the details (kinematics) of vibration-induced swimming. Kinematic analysis was conducted on *shank3-/-*,*syngap1*+/-, and wild type larvae, with 10 fish in each group. Each group was tested in intervals of 20 seconds, 15 times, vibrations were delivered by a stimulator with a 0.1 msec delay. In these trials the wild type were fairly consistent with respect to kinematic parameters, while mutant fish values were more variable. Parameters like latency and duration were more consistent between batches in day 5 and 6 *shank3* mutants. The wide range of values can be a characteristic of the phenotype. More trials are necessary to clarify the impact of the mutations in *shank3*and *syngap*1 on zebrafish behavior as a first step to understanding the broader question of the neurological basis for altered behavior in ASD.

P183 - *Syntomeida epilais* (Lepidoptera: Erebidae) Male Modulation Cycle: Normal or Inverted, Does it Matter?

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Moths with ears and acoustic emission organs emit sound when bats are approaching; these moths interact acoustically with them. *Syntomeida epilais* are rather unique; both genders emit acoustic signals, named modulation cycles (MC) with sexual dimorphism. Sanderford and Conner (1990) were the first to describe that in the MC of this species the first part, named active, has less intensity than the second, called passive. Our aim was to study if unrestrained, perched, virgin *S. epilais* females are able to detect the difference in amplitude between the active and passive parts of the male MC. Acoustic stimulation and recording from 10 females were done outdoors during the hours of normal mating behavior of *S. epilais*, between 3:00 and 6:30 am. The response used was the acoustic emission from a female when presented with two different stimulation series: one with normal MCs and the other with inverted MCs (first passive, second active). Each of these stimulation series were applied 3 times at each of the acoustic intensities used, between 53 and 89 dB SPL. Threshold was consider as the minimal intensity needed for females to respond to at least two out of three series applied. Threshold for normal MC series is 54.8 (SD 2.9) dB SPL and for the inverted MC series 64.4 (SD 11.1) dB SPL. Thresholds are statistically significant (Wilcoxon test, $p<0.05$). These results and

other data indicate that these females are able to differentiate these two types of MCs, responding better to the male normal MC.

P184 - Determining the effects of urbanization on the song of a vocal mimic, the gray catbird (*Dumetella carolinensis*)

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In an increasingly urbanized world, animals are faced with novel selection pressures such as anthropogenic light and noise, increased predation pressures, and changing community structures. The impact of urbanization on birds has seen a higher level of interest as drastic population declines have become commonplace, and conservation has become of utmost importance. The gray catbird (*Dumetella carolinensis*) is a vocal mimic belonging to the family Mimidae that breeds along rural-to-urban gradients throughout the United States. We hypothesize that urbanization impacts the mating signal, male song, of the gray catbird. We recorded male catbirds at multiple sites along a rural-to-urban gradient from the Shenandoah Valley of Virginia to the greater Washington D.C. Metro region. We quantified song differences between rural and urban male catbirds through investigating minimum and maximum frequency, duration, and repertoire composition and diversity. We predict that urban catbird song will have a higher minimum frequency than rural song, as higher frequency songs would avoid overlap from low-frequency human noise. Additionally, we predict that urban males will possess less diverse repertoires than rural males due to the lack of animal diversity in their ecological community. Thus far, preliminary analyses support our hypothesis that urban songs have a higher minimum frequency than rural songs ($n = 20$, $U = 7.72$, $p < 0.001$). Understanding how urbanization impacts the song characteristics of birds is essential to future conservation efforts as human impacts on the environment continue to alter ecological systems around the world.

P185 - Does the A-Call of a Chinese Blue-breasted Quail chick (*Coturnix chinensis*) change as it physically matures?

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Precocial Chinese Blue-breasted Quail (*Coturnix chinensis*, Galliformes) chicks produce several calls that appear to serve as contact calls between siblings and parents. One of the these, the A-Call, is given almost immediately after hatching. It consists of a main call ~3500 Hz and two harmonics located above at approximately 5000 & 8000 Hz. This call can function as a typical family contact call, and as the quieter harmonics attenuate over active space, can serve to indicate distance between individuals. Young chicks are very small (bee-sized) and grow very quickly over several weeks to their normal adult size. It is unknown if the A-Call changes over time as the birds physically change and mature. Newly hatched chicks were removed from the incubator and placed in a heated brooder, where a microphone recorded their vocalizations (early calls). As the chicks grew and matured they were moved into adult cages where their calls were also recorded and analyzed (late calls). Five spectral measures of the A-Call included low frequency (Hz), high frequency (Hz), frequency width (Hz), call length (sec) and average power or amplitude (dB). The results show that late calls were both broader than early A-Calls due to being significantly lower on the bottom end and significantly higher on the top end. The late calls were also significantly shorter (sec) and louder (dB) than the early calls. These changes in the A-Call are likely caused by the physical maturity of the chicks and may provide additional information about the age and size of the chick, in addition to the regular purposes of the A-Call.

P186 - Effects of Sublethal Imidacloprid on Acheta domesticus Neuron Firing Activity and Chirping Behavior

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The use of pesticides to enhance crop yield is becoming increasingly prevalent as the human population continues to rise. Imidacloprid, a pesticide within a class of insect neurotoxins known as neonicotinoids, is the prevailing pesticide for treating common crop pests such as aphids and whiteflies. Neonicotinoids are designed to chemically mimic nicotine and bind to the same nicotinic

acetylcholine receptors (nAChRs) within an insect's nervous system that nicotine would bind to. Lethal doses of the toxin can result in apparent intoxication, tremors, paralysis, and death of an insect, but sublethal doses have been shown to have unusual and unintended effects on non-target organisms. Honey bees, for example, have been shown to have a reduced ability to navigate to their hives after being exposed to sublethal amounts of the pesticide. Crickets, another example of a potential non-target organism, may be susceptible to undesirable effects as well. Due to the observed partial paralysis causing effects of the neonicotinoid, it was theorized that sublethal doses of imidacloprid could affect important aspects of a male cricket's chirping behavior, a characteristic vital for the reproductive success of the species. In this study, sublethal doses of imidacloprid were administered to crickets to investigate potential effects on chirp quality, for example, changes in the intra-chirp intervals which have been shown in previous studies to affect a female's recognition of the mating call. Changes in neuron firing activity were also directly observed to assess the extent to which neuronal activity was being impaired by the neurotoxin. Preliminary findings from this study suggest that imidacloprid both affects neuronal response to a stimulus and duration of chirping. The results from this study will be presented and discussed at the Association of Southeastern Biologists Conference Poster Session in April 2019.

P187 - The mechanism and consequence of differences in morphology between two egg mass morphs in spotted salamander (*Ambystoma maculatum*)

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The spotted salamander, *Ambystoma maculatum*, exhibits two egg mass color morphs, white and clear. Reasons for maintenance of the dimorphism have been explored, but no consensus has been reached. Previous work has shown that larvae from clear masses have greater mass than those from white. However, the mechanisms and consequences for this are unknown. *A. maculatum* embryos are known to have a mutualistic relationship with a green alga, *Oophila amblystomatis*, that benefits embryos by providing oxygen under hypoxic conditions. We hypothesized that clear masses facilitate greater algal growth than white masses, and that more algae lead to greater embryonic growth. To test this mechanism for the observed difference in hatchling size, we asked whether clear egg masses have higher algal density than white masses. To explore the consequences of differences in hatchling size, we quantified hatchling morphology and compared performance of hatchlings from clear and white masses. Specifically, we conducted laboratory swim trials and a mesocosm predation study to connect performance measurements across lab and semi-natural conditions. The relationship between laboratory testing and ecological relevance are often missing in studies of performance. This research is a strong step towards making those connections.

P188 - Does The Low Chip Call of the Chinese Blue-breasted Quail Chick (*Coturnix chinensis*) Qualify as a Low Amplitude Contact Signal?

Edward Mills

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Hatchling Chinese Blue-breasted Quail (*Coturnix chinensis*) produce several different calls to communicate with parents and precocial siblings. It is believed that low amplitude calls deteriorate over active space to help communicate distance and to reduce the attraction of predators. The previously unreported one-syllable low chip call has a fundamental or center frequency of 2908.23 Hz and is capped with by a small, shorter harmonic at 6002.78 Hz. This short chip call (0.08 sec) is produced at a lower amplitude (82.59 dB) than most of their other calls and may serve, along with the S-Call, as a short distance cue or signal for chicks to keep in contact with their siblings. The low chip call has not been recorded in adult birds. After hatching, quail chicks were moved from the incubator and placed together in a brooder. At the age of eight days, single chicks were placed in an adjacent room and isolated from their siblings for a period of five to ten minutes, and their vocalizations were recorded. Six spectral properties of the low chip call were measured and compared to other chick calls: call length (sec), amplitude (average and maximum power, dB), and sound frequencies (low, high and center, Hz). The results show that the low chip call is significantly shorter than other chick calls, has a lower center frequency and is produced at a lower amplitude than most of the other chick calls – including the A-Call, B-Call1, B-Call2 and the S-Call. The low chip is a low amplitude (aka

whispered) call produced by hatchling quail chicks that may possibly function as a distance cue and familial contact signal.

P189 - Is breeding-status dependent neural differentiation in Damaraland mole-rats context-dependent?

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Damaraland mole-rats (DMR; *Fukomys damarensis*) are one of two mammalian species that are eusocial. This social system consists of overlapping generations of adults, and only a single breeding pair within the colony, the remaining members are non-reproductive, but support reproduction of the breeders. Unlike eusocial insects, subordinate DMR retain the capacity to become breeders throughout their lifetime if they are paired with an opposite-sex, unfamiliar individual. As compared to other mammals, sexual differentiation of the central nervous system (CNS) is greatly attenuated. Interestingly, DMR do exhibit status-dependent differentiation of the CNS. Thus, the brains of breeders, both male and female, differ from non-breeders. The brain nuclei that differ based on social/reproductive status, include the principal nucleus of the bed nucleus of the stria terminalis (BNST) and the paraventricular nucleus of the hypothalamus (PVN), which are among the same nuclei that are subject to sexual differentiation by gonadal steroids in other rodents. Steroid-dependent sexual differentiation occurs during a critical phase of sensitivity and is permanent. It remains unknown whether the social/reproductive status-dependent brain differentiation in DMR is permanent or reversible. We addressed this hypothesis by altering the social/breeding status of individual DMR, some were paired with opposite-sex individuals permanently for 3 months, while others were paired for 3 months but then returned to their natal colony for an additional 3 months. We then analyzed the volume of the BNST and PVN in each group. The results will indicate whether the neural changes are plastic or permanent.

P190 - Possible Prey Switching Event in Puma concolor in Southcentral, New Mexico

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Prey switching events by apex predators signal important changes in community dynamics. We used remote camera and prey selection data collected over nine years in south-central New Mexico to determine if pumas (*Puma concolor*) have experienced a prey switching event from mule deer (*Odocoileus hemionus*) to elk (*Cervus elaphus*) as their primary prey. Our data suggest puma did switch primary prey species from mule deer to elk ($\chi^2 = 41.515$, $P < 0.001$). The trends in puma prey choice were significantly correlated with trends in mule deer and elk photo rates over the first half of the study period (elk increase: $t = 3.0758$, $df = 7$, $P < 0.05$; and, mule deer decrease until 2014 ($t = -8.1395$, $df = 3$, $P < 0.001$). Mule deer photos since 2014 have shown a steady and dramatic increase but this trend does not correspond with an increase in mule deer puma kills. It is likely that puma that learned elk as a primary prey search image early in life have failed to switch to mule deer as a primary prey species despite their apparent increase.

P191 - Black Bear (Ursus americanus) Response to Rising Annual Temperatures in Sierra County, New Mexico

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The long-term increase in average global temperature is a pressing environmental issue with consequences for numerous species. Populations of American Black Bear (*Ursus Americanus*) in semi-arid climates with seasonal rainfall and normally cold winters may be particularly susceptible to temperature increases due to water availability and disruption of normal periods of winter dormancy. We used 62 years of NOAA (National Oceanic and Atmospheric Administration) climate data, 1956 to 2018, and 10 years of trap camera data, 2008 to 2018, from Sierra County, New Mexico to answer three questions: (1) has there been a long-term increase in average annual temperature in Sierra County?; (2) has bear activity changed in our study site over the last decade? (3) what has been the relationship between black bear activity and temperature over the last decade? We found that between 1956 and 2018 average, annual maximum temperatures have been significantly increasing

(F= 12.97; df= 57; p= 0.0006; R^2=0.171), that average annual bear photo rates have significantly decreased (F= 2.539; df= 37; p= 0.055), and that bear activity, as measured by average weekly photo rates, significantly increases with rising weekly temperatures (MAD= 0.01406; df= 51; p< 0.00001). We hypothesize three possible explanations for these patterns. Average annual bear photo rates may be decreasing either as a result of declining population size, or as a result of bears avoiding higher temperatures by spending more time at the higher elevations neighboring our camera grid. Average weekly bear photo rates may be increase with weekly temperature averages as bears are driven seek out water sources more frequently in this semi-arid region. While we cannot be certain of the mechanistic relationship between bear activity and temperature at this time, we have documented a significant and compelling correlation between rising temperature and changes in bear activity at our study site.

P192 - Tail flicking in birds; could this behavior help in a noisy world?

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Sensory pollution by humans, sometimes referred to as anthropogenic pollution, can include an increase in noise, which may interfere with one or more sensory modality and an animal's ability to both send and receive (perceive) signals. Alarm calls, important signals for animals to avoid predation and warn conspecifics, may be particularly affected by urban noise, as they are often in the lower frequency range and thus have the potential to be masked. With a large selective pressure like increased predation, multimodal alarm signals with both an auditory and visual component may be selected for in noisier environments. Many birds combine visual displays with their alarm calls and flick their tails in response to the threat of predation. We examined the literature to find out which birds combine visual displays in conjunction with alarm calls and thus which birds may have a selective advantage in noisier urban areas. American Robins *Turdus migratorius* may be a good model system to investigate this further as they have successfully adapted to the urban landscape.

P193 - Differential Predator Avoidance in Southern Two-Lined Salamanders (Eurycea cirrigera)

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Many biotic and abiotic factors can operate to influence the distribution and abundance of species. In particular, organisms often shift their spatial and temporal distribution in response to predators. Salamander larval activity has been shown to be dramatically reduced in the presence of a fish predator. Amphibians that live in permanent water are vulnerable to this fish predation. Larvae of the Southern Two-Lined Salamander, *Eurycea cirrigera*, are found in both lotic and lentic water, although they are predominantly found in lotic environments. We tested the hypothesis that larvae of this species avoid fish species native to both habitats. We placed larval salamanders in a water-filled trough with a wire cage at one end. We then put an aerator in the cage. There were three treatment groups: (1) a fishless cage for a control, (2) a lentic species of fish (*Lepomis gulosus*), and (3) a lotic species (*Cottus carolinae*). Larvae significantly avoided *C. carolinae* but not *L. gulosus*. This could be due to the predominance of *E. cirrigera* in lotic environments, in which case they may not have developed an avoidance of fish found in lentic environments. Other factors could have contributed to these results as well, including the ability of salamanders to hide in the silt on pond bottoms. Future research will investigate similar species of salamander to determine if this pattern holds.

P194 - Olfactory fear learning alters spatiotemporal coding of olfactory stimuli

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Fear learning induces neuronal plasticity throughout the brain, including sensory regions specific to the conditioned stimulus (CS). However, little is known regarding how sensory plasticity might promote behavioral fear generalization, the expansion of fear from the CS to neutral, yet similar stimuli. The mammalian olfactory bulb (OB) presents an exceptional opportunity for studying this phenomenon due to the fact that each olfactory stimulus activates a unique subset of spatially distinct OB cells. The use of genetically encoded calcium indicators allows for direct visualization of the

distinct activation patterns in awake mice via wide-field or two-photon microscopy before and after olfactory fear learning. Wide-field imaging of awake mice reveals global olfactory fear learning-induced enhancement of nearly all OB glomeruli, which comprise the dendrites of OB output cells (such as mitral cells) that ultimately project olfactory information to higher processing centers. The plasticity is mediated by two distinct circuits, one of which is specific to the CS and the other which supports global, non-specific glomerular enhancements. The combined outcome of these two circuits increases the representational similarity of the CS and neutral odors, possibly setting an initial neural basis for behavioral generalization. Wide-field imaging encompasses several OB cell types that cannot be differentiated; however, two-photon imaging allows for single cell-resolution, enabling evaluation of how olfactory fear conditioning might differentially affect OB cell subpopulations. Current work demonstrates that fear learning alters mitral cell responses to neutral odors late in the odor presentation. Over time, as the cells respond to neutral odors they become more similar to that of CS-evoked responses, which may represent the mechanism by which learning increases the representational similarity of glomerular responses and might initiate downstream neural processes underlying behavioral generalization.

P195 - Investigating the Influence of Small-Scale Light Pollution on Bat Activity

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Large-scale light pollution is widely documented to have deleterious effects on many nocturnal species, including bats. However, the full extent of these effects, and how they scale with light size and intensity, are not well documented. Previous studies investigating the influence of lights on bat activity have typically concentrated on large-scale light pollution, but smaller scale pollution is pervasive and actions taken by individuals may mitigate any negative effects. Our specific objective for this study is to determine what, if any, effects residential-type security lights have on bat activity in habitats with otherwise limited anthropogenic sources of light. To achieve this objective, we used acoustic detectors to measure bat activity both with and without the presence of an artificial light source. Using this general approach, we conducted a pilot study to refine field methodology between October and November of 2018 in Hall and Jackson counties. Preliminary data were inconclusive, most likely because of overall low bat activity associated with this time of the year, but our methods showed promise as an approach to evaluate the influence light on bat activity. The study will resume in the upcoming spring and summer of 2019, and during this period of increased bat activity, we will attempt to quantify the effects of small-scale light pollution on native bat populations in northern Georgia. Keywords: light pollution, bats, nocturnal, anthropogenic effects, north Georgia, Chiroptera.

P196 - Mechanosensory sensitivity of naïve hawkmoths

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Manduca sexta are large, nocturnal hawkmoths that feed on nectar by hovering in front of a flower while probing its surface with their long proboscis. We have previously identified two distinct behaviors that moths use while probing the flower in order to find the nectar reward. One probing behavior involves the tapping of the corolla surface with the proboscis while maintaining a steady distance from the flower; these exploratory movements primarily occur on flat surfaces. The other probing behavior is elicited upon detection of 3-dimensional features of the surface, and consists of back-and-forth flying movements, which result in the proboscis sliding, for example, along corolla grooves. Taking advantage of this conspicuous behavior, we are using 3D printed disks with grooves of decreasing width as surrogate flowers to determine the mechanosensory spatial sensitivity of the proboscis. Moths frequently display the back-and-forth behavior on the disc with the thinnest grooves (width: 0.1 mm), strongly suggesting that the moths can detect these grooves. We are currently exploring ways to make even thinner grooves to determine the spatial sensitivity threshold of this mechanosensory system.

P197 - Consistency of Personality Traits in Meadow Voles, Microtus pennsylvanicus

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Many studies of animal personality measure a trait at a single time point in the life of the animal. The consistency of these traits over the animal's lifespan is neglected. We measured exploration, activity, and boldness of meadow voles, *Microtus pennsylvanicus*, in two novel object tests six times every two months over a year, representing a large proportion of the lifespan of the vole. We found that activity was consistent across time, however exploratory behavior and boldness increased with the vole's age. This data on exploration and boldness is counter to the hypothesis that personality traits would be consistent over an individual's life. The three personality traits of meadow voles did not vary by sex or litter, despite our hypothesis that the different familial lines and life histories of the sexes would produce differences in personality. The exploratory behavior and boldness of each litter did develop differently over time, the opposite of our hypothesis that litters might vary similarly to each other. And the interaction of litter and sex over time also impacted the exploratory behavior of an animal, in accordance with our prediction that sexes would differ, but combined with the opposite of our prediction on litters. Given the effects of time on personality traits, it suggests that some traits can be modulated to adapt to life history stages and that family lines may evolve divergent strategies to do so.

P198 - Parental Investment in Relation to Mate Quality: An Experimental Test

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Since parental investment is costly, parents should adopt different investment strategies to maximize their fitness given current conditions. A mate's phenotype is one variable by which parents might adjust their investment levels, and this is usually viewed in the context of two main hypotheses: differential allocation and compensation. The differential allocation hypothesis posits that, when an individual is paired with a mate of high phenotypic quality, however defined, this individual should supply higher levels of investment, but when paired with a mate of low quality, this individual should invest less. Alternatively, the compensation hypothesis predicts higher levels of investment when paired with low-quality mates to compensate for being paired with an individual of lower quality. We tested these hypotheses in a wild population of Prothonotary Warblers (*Protonotaria citrea*) by experimentally manipulating male wing length. Preliminary, correlational data suggested that a male's size, especially the length of his wings, is a trait that females find attractive, and that both females and males differentially invest in offspring according to this trait. Thus, we predicted there would be differences in parental investment levels between males and females of mated pairs in which the male's wings were shortened, versus those in which wing length was not altered. Recent experimental findings suggest that females provision offspring more, and males provision less, when males have longer wings, whereas when males have shortened wings, females provision offspring less, and males provision more. Thus, both females and males altered their investment level in response to changes in male phenotype. Because these behavioral changes differ depending upon the relative difference in size between mates, our results suggest that individual reproductive strategies vary facultatively according to the phenotype of one's mate.

P199 - Differences in the number of birds flushed in response to calls given by bird eating and non-bird eating hawks at a feeding station in northwest Tennessee

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Recognizing potential threats can influence the energetic demands, and therefore the survival, of wintering birds. Reacting to sounds that are not a threat wastes time and energy that could be spent foraging. Our goal was to determine if birds visiting a feeding station were more likely to flush upon playback of calls from non-bird eating hawks (non-threat) as compared to the calls of bird-eating hawks (threat). Our study site was a feeding station located in an upland hardwood forest. Feeders were baited with suet, black oil sunflower seeds, thistle, corn, and peanuts. The feeding station was easily observed from a permanent blind. We used a Bluetooth speaker paired with a smartphone to project calls using the Merlin Bird ID application. We played the calls of Red-tailed Hawks (*Buteo jamaicensis*) and Red-shouldered Hawks (*Buteo lineatus*) as a non-threat and the calls of Cooper's Hawks (*Accipiter cooperii*) representing a potential threat. We allowed the feeders to populate with birds then counted the number of birds visiting the feeding station. We then counted the number of birds present at the feeders after playback. The mean number of birds present after the playback of Cooper's Hawk calls was significantly less than the number of birds present before playback. There

was no difference in the number of birds present before and after playback of Red-tailed Hawk and Red-shouldered Hawk calls, suggesting that songbirds may be distinguishing between the calls of bird eating and non-bird eating hawks.

P200 - The effects of ambient noise and variation within vocalizations on avian behavioral response

Jacob Gerber

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Noise pollution is one of the pressing problems affecting the natural world, with a range of species impacted by the effects of increased ambient noise due to urbanization. The aim of this study is the quantify the effects of noise pollution on the environment, specifically, by studying Carolina Chickadees (*Poecile carolinensis*). We examined the effects of anthropogenic noise on avian vocalization and behavior. We measured frequencies and amplitudes of Carolina chickadee alarm calls and tested if vocalization frequency or amplitude differed as a function of anthropogenic noise level and overall variation in soundscape. We observed Carolina chickadee behavioral responses along a gradient of noise with randomly selected variable frequency chickadee vocalization playbacks to test the proximate functionality of possible vocalization shifts. Preliminary results suggest minimum chickadee vocalization frequency was slightly higher in areas of high anthropogenic noise disturbance. This research fills in the gap in preliminary results by measuring a gradient of ambient noise environments and having multiple, randomly selected alarm calls being played to measure functional behavioral response rather than one high and one low frequency alarm call. Based on these results, we were able to quantify the impacts of anthropogenic noise on the behavior of avian communities.

P201 - Antlion Species Diversity in Gwinnett County Using Morphological Features and Principal Component Analysis with a Genetic Analysis of the CO1 Gene

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Antlions, also known as doodle bugs (Family: *Myrmeleontidae*), are insects found around the world, including Gwinnett County, Georgia. Antlion larvae are ambush predators that build pits in the sand to capture their prey. Their main food source are ants and other small prey that fall into the antlion pits, including other antlions. There are approximately 100 or more antlion species in North America. The main goal of the project is to determine various morphological features that can distinguish different potential species present in Gwinnett County, Georgia, and to create an identification chart based on genetic analysis using the CO1 gene. The hypothesis is that there are at least three species existing locally. In this experiment, we will be using a principal coordinate analysis (PCA) to obtain a set number of species for Gwinnett County. This data will then be tested against DNA sequencing of the CO1 gene in another experiment. Through the use of DNA analysis, we will investigate the DNA sequences of the antlions we have collected in order to differentiate the species.

P202 - Characterization of the wetting properties for antion (Myrmeleontidae: Neuroptera) mouthparts and its role in the feeding process

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Antlions are best known for the ambush feeding behaviors of their predatory larvae. Using their funnels built of sand and dirt to trap prey, the antlion larvae attacks with large, powerful mandibles, followed by extraoral digestion due to venom. Although the general feeding habits for antlions are known, there are no detailed accounts of the feeding mechanism, including how venom is injected and the path of fluids for ingestion. Here, we use scanning electron microscopy coupled with wetting experiments to reveal the feeding mechanism of antlions. Our preliminary results indicate that a venom pumping mechanism and wetting dichotomy play an important role in delivering venom and subsequent ingestion of fluids.

P203 - Investigating the cause of success or failure of honey bee hives near Davidson, NC

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Colony Collapse Disorder (CCD) is an unexplained phenomenon that affects honey bee (*Apis mellifera*) colonies around the world. Davidson College has lost hives overwinter every year for the last several years. While many hives in Mecklenburg County, NC, where Davidson College resides, also collapsed, some bee keepers within a one-mile radius, however, did not lose their hives. This suggests that there may be specific intra-hive factors that affect honey bee colony success or failure. Factors that have been suggested in the literature include pathogens (e.g., viruses), pesticides (e.g., miticides or neonicotinoids), or parasites (e.g., mites). We collected 10-15 bees every two weeks from one hive at the Davidson College farm from May 2017-November 2017. This hive did not survive the winter. We next collected 25-30 bees from over one hundred individual hives once during spring 2018. We also surveyed the beekeeping practices of the beekeepers. We then used molecular techniques to determine the presence of mites and the microbiomes of each of 111 hives. This spring, we will revisit each hive to determine its success or failure over the winter of 2018-2019. The goal of our research is to correlate the presence or absence of different factors (presence/absence of mites, diversity of the microbiome, beekeeping techniques) with success or failure of hives. To date, we found that 78% of beekeepers surveyed treat their hives with pesticides. We found that microbiomes of most hives are dominated by *Lactobacillus apis*, and hives had an average of 54.4 (+/- 24 s.d.) bacterial 16S rRNA amplicons identified to the genus. Our study is unique in its comprehensive approach to the study of honey bee hive collapse.

P204 - Staining experiments with Synophrya, a parasitic ciliate found within the gills of portunid crabs

Tiffany Taylor, Stephen Landers

Troy University, Troy, AL

Synophrya is a parasitic ciliate that invades the gills of marine decapods. The protozoan absorbs blood from the host, and expands to a large stage known as the hypertrophont. Recently, *Synophrya* was discovered in the gills of the portunid crabs *Achelous gibbesii, A. spinimanus,* and *A. ordwayi* near Savannah, Georgia. In collaboration with the Skidaway Institute of Oceanography, we stained the ciliate with silver nitrate to confirm the genus identification, and used Mayer's hemalum to confirm the presence of the characteristic macronuclear reticulum. The results showed hypertrophont stages ranging from 25-1125 µm in length. The ciliature consisted of nine kineties that ran from the anterior to the posterior pole, consistent with the genus. Stages of macronuclear degeneration were observed, ranging from fully intact macronuclei to those degenerated into multiple islands of chromatin throughout the cytoplasm. This degeneration is thought to result from the death of the parasite due to being isolated by the host's immune response.

P205 - Containment of a Cryptosporidium serpentis outbreak in a snake collection - A case study

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West Liberty University, Dept. of Natural Sciences and Mathematics, West Liberty, WV

Cryptosporidium is a parasitic apicomplexid that causes respiratory and gastrointestinal illnesses across many vertebrate species. Infections in mammals and birds rarely prove fatal in healthy adult animals. However, in reptiles, the infection will most likely become lethal. Specific to snakes, *Cryptosporidium serpentis* infects the gastrointestinal tract and causes hypertrophy of the mucosa of the stomach resulting in the inability to pass food down the gastrointestinal tract. Disease pathology is known, but a proven cure for this disease in snakes still remains unknown. When infections arise, most zoological institutions rely heavily on quarantining and euthanasia to deal with this highly contagious and lethal disease. On December 1, 2018, a case of the disease was confirmed within the West Liberty University Zoo Science Snake Collection. To maintain the health and safety of the collection and prevent further spread of disease, major steps were taken through sanitation practices and fecal testing to track disease outbreak back to a case 0. Herein, we report individual snakes that had *Cryptosporidium* spores present but were ultimately able to pass the infection and return to a

disease-free state. Therefore, evidence exists within this collection that a particular clade of snakes may prove to be more disease resistant than others. We also report an active strategy to isolate diseased individuals and contain a *Cryptosporidium* infection outbreak in a large snake collection.

P206 - Ants (Hymenoptera: Formicidae) of Mississippi

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The first faunal surveys of ants in Mississippi were done by Marion Smith from the early 1920's through the early 1930's. Smith made signification contributions to our knowledge of Mississippi's ant fauna by finding many new state records and discovering several new species. As a result of these surveys, Smith reported 136 taxa of ants from Mississippi including 103 species and 33 additional subspecies and varieties. However, since Smith's time there have been numerous taxonomic changes, and the 136 taxa reported by Smith now represent only 108 species. It was not until 2001, when the Mississippi Entomological Museum (MEM) began faunistic surveys for ants in Mississippi, that the ants of Mississippi were revisited. As a result of these recent surveys and other revisional works by various researchers, 191 species (plus the hybrid fire ant *Solenopsis invicta* X *richteri*) in 9 subfamilies and 40 genera are now known to occur in the state. Most of the species in Mississippi are native, with 30 being exotic. Our largest percentage of species are Myrmicinae (56%), followed by Formicinae (24%), Dolichoderinae (6%), Ponerinae (5%), Proceratiinae (3%), Dorylinae (2%), Pseudomyrmicinae (2%), Ectatomminae (1%), and Amblyoponinae (1%).

P207 - Decomposition of Cattle Dung by Aphodius pseudolividus in Virginia is Density Independent

Kaitlyn Harless, Patrice Ludwig

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Dung beetles are responsible for a multitude of ecosystem services including the decomposition of dung pats, which in turn enriches the soil with nutrients for local vegetation to utilize. There are three different types of dung beetles in North America; rollers, tunnelers, and dwellers. Research suggests a positive correlation between density of tunneler dung beetles and the rate of dung decomposition (Yamada, 2006). We built on this finding with an experiment to determine the effect dweller dung beetles have on the rate of decomposition of cattle dung. The density of a dweller species, *Aphodius pseudolividus*, was manipulated for this field experiment. The number of individuals per sample was determined by the natural density of *A. pseudolividus*, which was found to be 40 individuals per pat. A control treatment of dung that was not manipulated from the field was also used. The 0.5 kg frozen and thawed dung samples were placed according to a randomized plot design had either half, equal to, or double the natural density of *A. pseudolividus*. Replicates were destructively sampled on days 1, 2, 4, and 7 and the control destructively sampled on day 7. The wet and dry mass (g) and moisture (%) of the samples were measured. The dry mass of the dung was measured for all samples after collection, the dry mass was then used to determine the amount of decomposition that had occurred. Decomposition was defined as the difference between the control and experimental pats. It was expected that pats with a higher density of *A. pseudolividus* would also have the highest amount of decomposition. The data, however, showed no significant difference between treatments. This could mean that dweller species are not efficient decomposers or that the species used was too small in size to make a significant difference.

P208 - Identifying Digenetic Trematodes Infecting Elimia virginica snails and Cyprinid fish in Eastern Virginia

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Digenetic trematodes are endoparasitic flatworms which can have medical, economic and ecological effects such as causing schistosomiasis in humans, loss of fish harvest, or altering host behavior. All trematodes require two hosts, a mollusk and a vertebrate to complete their life cycle. However, the identity and life cycles of many trematodes that are not economically or medically important are unknown. Identifying larval trematode stages is difficult because they are morphologically cryptic,

however molecular techniques can be used to identify larval stages by matching them to adults. Here we try to identify trematodes infecting the freshwater snail *Elimia virginica* and Cyprinid fish (potential definitive hosts) collected from the Rappahannock and Little River in Virginia using cytochrome c oxidase (COI). *E. virginica* and Cyprinids were dissected for parasites, which were then preserved in ethanol. Parasite DNA was extracted, then the COI gene region was amplified using DICE1F and DICE11R primers and sequenced. DNA was extracted from 39 parasites collected from *Notropis hudsonius, Cyprinella analostoma* and *E. virginica* hosts. Of those, 9 sporocysts from *E. virginica*, 2 metacercariae from *C. analostoma,* and 2 metacercariae and 1 adult from *N. hudsonius* were successfully sequenced. Comparisons with known sequences revealed that sporocysts from snails most closely matched trematodes from the families Opecoelidae, Clinostomidae, Diplostomidae, Fasciolidae and Cyathocotylidae. Metacercariae and an adult from fish most closely matched the families of Opecoelidae and Clinostomidae. We found two matches between life stages. *Clinostomum marginatum* was found in both *E. virginica* and as a metacercaria in *C. analostoma*. Also, a genetically identical metacercaria and an unknown Opecoelid adult were found in two different *N. hudsonius.* However, we have not yet matched a sporocyst to an adult. More DNA sequences from different trematode life stages are required for identifying the complete life cycle of a species.

P209 - Effects of ant chemical secretions on deterring myrmecochore seed mortality agents

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Seed dispersal is a critical portion of the life cycle of many plant species. In eastern North America, many of these species rely on ants to distribute seeds away from the parent plant through the seed dispersal process known as myrmecochory. Ants pick up seeds with elaiosomes (fleshy seed coat appendage), transport these diaspores (seed plus elaiosome) to their nest, remove elaiosomes from the seeds, and feed the elaiosomes to developing larvae. Seeds are then either re-dispersed out of the nest to nearby locations or remain in the nest. Ants have several glands that secrete chemicals, which may coat the seed during the dispersal process and further deter seed predators after the ant has discarded the seed body. Whether chemicals from ant glandular secretions affect myrmecochore seed fate by deterring mortality agents has not been tested; such research is needed to better understand the role of ant-produced chemicals on seed and plant survival. Some mortality agents for myrmecochores include herbivores, frugivores, parasites, and pathogens. We conducted field experiments at Mountain Lake Biological Station (Giles Co., Virginia) to investigate whether the presence of pentadecane, a chemical found in *Aphaenogaster* secretions, influences rodent seed predation when present on seeds. We found that the presence of pentadecane did not influence rodent seed predation of *Sanguinaria canadensis* or *Asarum canadense*, two common myrmecochores in eastern deciduous forests of the U.S. However, numerous microorganisms, such as pathogenic fungi, have been identified as mortality agents in the seed dispersal system. Future experimentation in this system will focus on the effects of ant glandular chemicals on microorganisms, such as the pathogenic fungus *Botrytis cinerea*. These experiments will provide important insights into the chemical ecology of myrmecochory.

P210 - Staining experiments with the ciliated protozoan known to cause shrimp black gill disease in Litopenaeus setiferus

Meet Patel, Stephen Landers

Troy University, Troy, AL

A number of crab and shrimp species on the Georgia coast are known to exhibit black gill disease due to a recently reported apostome ciliate. This ciliate is found encysted on the gill tissue where it has been implicated in harming the host by causing melanization and in negatively affecting the shrimp fishery in the South Atlantic Bight. The ciliature of this parasite has not been described for a species identification however. In collaboration with the Skidaway Institute of Oceanography, encysted ciliates attached to gill tissue from the white shrimp *Litopenaeus setiferus* were examined using silver nitrate staining to detect the ciliary pattern on the cell surface. Additionally, hematoxylin was used to reveal the macronuclear structure. The ciliate cysts averaged 42 X 36 µm and had a single macronucleus. The cell was typically solitary but was able to divide within its cyst wall. In rare cases, the ciliate was observed to invade the host gill. Silver nitrate revealed that the cell has a ciliature similar to the harmless apostomes *Hyalophysa* and *Gymnodinioides*. Continuing work on this

parasite is aimed at discovering the complete ciliature for a species identification or new species description.

P211 - Application of the electroretinogram (ERG) to assessing the visual system of fruit fly Drosophila melanogaster eye-shape mutants

Shuaitong Chen, Emily Daniels, Barry Rhoades

Wesleyan College, Macon, GA

The electroretinogram (ERG) is a field potential response across the visual system to a simple light flash stimulus. In *D. melanogaster* the ERG is a superimposition of a surface-negative slow wave extending through the duration of the light flash originating in the retinal sheet of ommatidia with surface-positive onset and surface-negative offset transients originating in the deeper lamina. This study used ERG recordings to assess photoreceptor response and visual system neural processing in two *D. melanogaster* eye-shape mutants, bar-eyed and lobe-eyed. The development of the bar-eyed mutant results from the duplication of the *Bar* gene on the X chromosome in which the mutation behaves as a semi-dominant. The lobe-eyed mutant results from an autosomal dominant *Lobe* gene mutation that encodes the PRAS40 ortholog necessary for eye cell survival. Each individual fruit fly was mounted within a pipetter tip, with the protruding head immobilized with cyanoacrylate glue. Pulled glass capillary microelectrodes were positioned on the surface of the retina and within the thorax. The dark-adapted fly was stimulated with a one-second flash of a white LED light at 330 Lux while the ERG response was DC recorded. Recorded ERGs for wild-type flies conformed to the ERG components reported in previous studies. The ERG of lobe-eyed flies was indistinguishable from the ERG of wild-type flies while bar-eyed flies showed no ERG response. This suggests that the lobe-eyed mutant has a functional visual processing system while the bar-eyed mutant is functionally blind. Interestingly, wild-bar hybrid females which have the *Bar* duplication on only one X chromosome showed an intermediate ERG response with reduced amplitudes relative to the wild-type, indicating a partially functional visual system.

P212 - Insect emergence from a disturbed headwater stream in Southern Appalachia

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Appalachian headwater streams are biodiversity hotspots. Many of the insects that inhabit these streams are highly sensitive to changes in water quality and go through a process known as emergence, where they leave the stream as adults. This serves as an important link between the aquatic and terrestrial food web, like bat, bird, lizard, and arachnid diets often depend on emerging insects at certain times throughout the year. Emergence is also the primary method that nutrients are made bioavailable and cycled back to the forest from the stream. However, invasive mining operations are common in southern Appalachia and present a unique challenge to stream ecosystems. The purpose of this research was to compare insect emergence from an undisturbed reference stream, located within an old growth forest, to that of a nearby stream, with similar hydrology, that has a history of mining. This was done by placing five traps, intended to collect emerging insects, over pools at each site for 11 days and emptied every 48 hours. Insects collected were preserved in alcohol, identified to order, and grouped into the morphospecies groups: chironomid, EPT, and miscellaneous for statistical analysis. Species richness, abundance, and the total number of individuals were compared between sites. Results showed a significantly higher number of individuals and 20 unique species from the reference site. Chironomid midges comprised ~80% of the samples from both sites. A ~30% decrease was observed in all morphospecies groups when comparing the reference stream to the disturbed stream. This could directly impact the riparian food web and biodiversity as the distribution of many insectivores has been observed to shift in response to insect emergence. This study highlights the need for future research into the effects of mining-related disturbance on insect emergence in this region.

P213 - Grain Properties and Selection of Pogonomyrmex rugosus Mounds

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The populations of Pogonomyrmex rugosus within Sevilleta National Wildlife Refuge construct their mounds with various rock types depending on location and source materials. Each available rock type has a unique thermodynamic property due to mineral composition. Additionally, thermal properties of a rock may vary due to grain size. The purpose of this study is to determine whether Pogonomyrmex rugosus are constructing their mounds in a way that corresponds with the thermodynamic properties of the selected grains. With surface temperatures currently reaching over 65° C during the day and projected to increase over the next 50 years, it is critical to understand how P. rugosus tolerate the extreme heat. Methods in this study include identifying over 8,000 grains to create a composite thermal conductivity measurement for each mound. In addition, 24 hour thermal scans were taken to measure heat movement throughout the mounds over the course of a day and one mound was epoxied to determine grain change at depth. This study concludes that there is no overarching correlation in thermal conductivity and grain placement in the mound when looking at multiple ant mounds across the Sevilleta National Wildlife Refuge; however, there are consistent trends in grain placement when looking at an individual mound. These results imply that ants are incorporating thermal conductivity of the mound in a case by case pattern rather than an overall trend and inspires future studies on this topic. Additionally, understanding the grain selection of P. rugosus will broaden our knowledge on how the unique geology of Sevilleta National Wildlife Refuge affects the organisms and how these organisms have adapted to the intense environment.

P214 - Systematic Studies of the Cambarus longirostris (Longnose Crayfish) Complex

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In 2015, a range wide systematic evaluation of *Cambarus longirostris* revealed the existence of three undescribed species. Subsequent continued systematic studies of this species complex identified two additional putative species in the northern and central portions of *C. longirostris* range. *Cambarus* sp. B occurs at a few locations in the upper Savannah River drainage of South Carolina, and has historically been considered a bait bucket introduction. *Cambarus* cf. *longirostris* occurs in the Upper Holston River and Clinch River drainages, and has historically been considered either *C. longirostris* or *C. girardianus*; however, we consider it to be morphologically closest to *C. longirostris*. Evaluation of qualitative characters (e.g. chelae, rostrum, suborbital angle) are sufficient to distinguish *C.* sp. B from *C. longirostris* and similar species. Multivariate analysis of chela morphology indicates that *C.* cf. *longirostris* differs from *C. longirostris* and morphologically similar taxa. *Cambarus* sp. B is known from only four of nine historical sites in the upper Savannah river drainage in Oconee County, SC, and most of its historical range has been inundated by reservoirs. Because of this, the conservation status of *C.* sp. B is considered Endangered using American Fisheries Society criteria. The range and distribution of *C.* cf. *longirostris* is not completely known at this time. *Cambarus* cf. *longirostris* conservation status should be considered Threatened using these criteria.

P215 - Individual-level foraging niche variation in the omnivorous Eastern Box Turtle, Terrapene carolina

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Individual-level ecology is a concept that focuses on examining variation in resources use or behavior among individuals in a population or species. Studies that focus on the species or population as the units for comparison may overlook inter-individual specializations, preferences, or tolerances that are important for population dynamics, ecology, evolution, and conservation. We examined individual variation in the foraging niche within a population of omnivorous Eastern Box Turtles (*Terrapene carolina*) using stable isotope analysis. We compared carbon and nitrogen isotope ratios from turtle claw samples to that of various locally available food items including fruits, mushrooms, and invertebrate animals. Claw samples are known to accumulate material from dietary resources over medium temporal scales and thus potentially offer a useful bioindicator of foods the individual has consumed over the past several weeks or months. We hypothesize that the isotopic signatures of the turtle claws will indeed be variable and reveal individual-level food specializations or preferences

within the population. If so, this finding could have implications for the conservation and management of this declining species across its broad geographic range.

P216 - Effects of Wildfire and Timber Harvest on Terrestrial Salamander Populations in the Southern Appalachians

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Timber harvest and wildfire are two of the most common ecological disturbances influencing Southern Appalachian forests and there is a need for well-informed management practices. Terrestrial plethodontid salamanders are excellent focal species for examining the effects of disturbance on forest ecosystems. They are present in high densities and their susceptibility to desiccation restricts their available habitat to only those areas with stable conditions falling within a narrow temperature and moisture range. For ten years, we have conducted a mark-recapture study investigating the effects of timber harvest on terrestrial salamander populations at 16 study plots. In 2016, half of these study plots were burned in a wildfire, creating a unique opportunity to discern the combined effects of multiple disturbance events. Our treatments include burned and unburned timber cuts along with unharvested control forest, both burned and unburned. We collected detailed habitat data in the two years following the wildfire, to examine the effects of disturbance on the microclimates which salamanders depend on. We calculated a Composite Burn Index score using various habitat parameters indicative of burn intensity and compared this index with salamander counts across all treatments. Preliminary analyses reveal measurable differences in leaf litter depth among treatments and across years, including significant decline in salamander captures in post-fire burn plots. Reduced habitat quality has likely had a negative short-term influence on salamander populations in the most severely disturbed areas.

P217 - Examining the contact zone between northern and southern two-lined salamanders (Eurycea): Has hybridization occurred?

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Two-lined salamanders (*Eurycea* Plethodontidae) are distributed from southeastern Canada to the Gulf Coast and westward to Louisiana, Arkansas, and Illinois. More specifically, the Northern two-lined salamander (*Eurycea bislineata*) range extends from eastern Canada to mid-Virginia, and the Southern two-lined salamander (*Eurycea cirrigera*) range extends from mid-Virginia to the southern United States. The ranges of these two species meet along the North Carolina and Virginia border, allowing limited interactions and thus, an opportunity to test for evidence of introgression. Previous research confirmed a major phylogenetic break between the Northern and Southern two-lined populations. Through DNA sequencing and morphological analysis, we aimed to determine whether hybridization has occurred within the contact zone. In order to ascertain the phylogenetic position of these populations, we amplified, purified, and sequenced base pairs of the mt-ND2 gene for eighty-eight specimens collected from the contact zone. We then expanded upon our findings by computing and comparing dorsal and ventral measurements for each specimen using morphometric analysis in the Geomorph R software package. Our results support the presence of hybridization among the populations of Northern and Southern two-lined salamanders interacting within the specified contact zone.

P218 - When, how, and why do snakes move? A case study validating internal implantation of accelerometer data loggers to remotely and continuously monitor movement behavior of wild snakes

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Answering questions of how, when, and why animals move allow deeper understanding of their biology and ecology. Recent advancements in animal biologging technology enable field studies to acquire expansive movement and behavioral data sets in a remote and fine-scale manner. Tri-axial

accelerometers (ACTs) allow scientists to remotely and continuously monitor movement in three dimensions without limitations of observer presence, terrain, weather, or space and have been primarily implemented in studies of aquatic and large-bodied organisms. Miniaturization of ACTs expands their application to a greater diversity of potential study organisms. Using accelerometry in combination with radio telemetry, we validate the internal implantation of these data loggers in Western Diamond-backed Rattlesnakes (*Crotalus atrox*) and conduct field behavior observations to create a methodological framework for studying movement ecology of cryptic species. With this model, periods of movement and non-movement can be recognized and distinguished as well as several specific activities and body positions. Continued data collection could enable further development of this model to recognize all specific activities within movement and non-movement categories. Continued miniaturization of data loggers present opportunities for future studies of even smaller study organisms including an increased number of females and smaller, more cryptic snake species.

P219 - Importance of fire and water chemistry in explaining twenty years of change in amphibian communities of the Francis Marion National Forest

Nicole Strauss, Daniel McGlinn

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Fire plays a vital role in management of longleaf pine ecosystems. Current management practices target the restoration of longleaf plant communities which require frequent prescribed fire; however, the effect of disturbance on animal communities is not as well understood and these communities may be detrimentally impacted by high fire frequency. The purpose of this study was to compare the importance the burn regime and water chemistry in helping to explain change in the amphibian community in the Francis Marion National Forest over the past 20 years using an observational study. Specifically, we resurveyed 15 ponds and recorded species presence using minnow traps and calling censuses. We also recorded leaf litter mass, pond water chemistry, and the frequency and time since last prescribed fire. The burn history of the ponds ranged less than one year to over 20 years without fire. We are still processing the data from our 2018 survey but the historical survey suggests that time since fire had a significant negative effect on amphibian abundance and diversity. Water chemistry however was more important than time since fire and largely appeared to reflect habitat differences between ponds with more hard wood forest rather than pine forest. We will compare our modern community data to the historic dataset using multivariate ordinations and linear regressions. Specifically, we will examine to what degree changes in the fire regime versus changes in the water chemistry help to change shifts in the herpetofaunal community structure and diversity. Our results have important implications for our understanding of how disturbance interacts with inherent environmental heterogeneity to structure species that are sensitive to fire.

P220 - Mate-guarding and pair-bonding behavior in green salamanders, Aneides aeneus

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Male *Aneides aeneus* arrive at home crevices and establish territories through chemical deposits and often aggression with other males. Females usually follow soon after. Thus, male-female pairs are formed in single rock crevices or in adjacent crevices for periods of days or weeks mainly in May and October. Pair bonding occurs that likely involves chemical and tactile communication. Males and females may gain familiarity with each other. Male-female pairs are often in direct contact as males may have a limb or other body part resting on the back or tail of females. Also, heads of male and female may be oriented to opposite ends of crevice openings with posterior ends in contact. This may be a defensive response to predators. Pairing increases chances of courtship and mating, and allows for mate guarding thus reducing chances for polyandry and polygyny. Some aggression by males may occur such as biting and snout-pressing, which is similar to behaviors observed during courtship and mating. Males that have established and defended territories are likely more fit. Thus, mate-guarding behavior may be selected for in that females may choose more fit males. Aggressive defense of territories by males combined with the formation of male-female pairs and pair bonding indicates that mate guarding occurs in *A. aeneus*. This may enhance reproductive success of both males and females.

P221 - Habitat Characteristics of the Rare Patch-nosed Salamander (Urspelerpes brucei)

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Piedmont College, Demorest, GA

Urspelerpes brucei is a rare, recently described lungless salamander (Plethodontidae, Hemidactyliinae, Spelerpini) endemic to extreme northeastern Georgia and adjacent western South Carolina. Within these areas, individuals have only been found in 17 first- and second-order streams. Occupied streams are characterized by small sizes, shallow waters, and steep-walled ravines. Most streams also show an abundance of heath (*Rhododendron sp.*) along their banks. We measured five variables likely important to *U. brucei* habitat at each of 14 occupied streams: water depth, water-flow velocity, aspect, width of streambed, and slope. We also used previous trapping data of larvae to test whether water depth was related to capture rate. Mean water depth and mean streambed width were significantly correlated ($r = 0.779$; $P < 0.001$) as were slope and flow velocity ($r = 0.592$; $P = 0.024$). Mean slope ranged from less than 4° to over 23°, and flow rate ranged from 0.2 to 0.6 m sec^{-2}. Water depth was the most variable while ravine width was the least. Aspect was highly variable, ranging from due north through due south. Capture rate of larvae was strongly related to water depth ($P = 0.006$), corroborating earlier observations that *U. brucei* is a true headwater species. We hypothesize that the single population in South Carolina was isolated from other populations by the sudden increase of water flow caused by the stream capture event where water from the Chattooga and Tallulah rivers was diverted from the Chattahoochee to the Savannah drainage.

P222 - Initial assessment of Terrapene carolina status and trends in North Carolina using 10 years of data from the Box Turtle Connection

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Turtles are among the most imperiled vertebrate groups worldwide, with nearly half of all species listed as vulnerable to extinction. The Eastern Box Turtle (Terrapene carolina) is a widespread and once common species throughout the eastern United States, but a number of localized long-term studies have identified population declines over several decades. Now more than half of states in which box turtles occur list them as a species of conservation priority. Using data collected as part of The Box Turtle Connection (BTC), we analyzed population trends, vital rates, and demographics at 39 protected sites across the Coastal Plain, Piedmont, and Blue Ridge physiographic regions of North Carolina over a 10-year period. The BTC has recorded 3,761 captures of 3,082 individual turtles through 2017. Data were sufficient to estimate annual capture and survivorship probabilities stratified by demographic groups (juvenile, adult male or female) for 21 populations. Population densities ranged from 0.15 – 6.0 turtles/ha, and population sizes were generally stable over time within sites. Annual capture probabilities ranged from 0.01 – 0.23 among sites, and annual survivorship (adjusted for temporary emigration) was 0.86, 0.90, and 0.95 in Piedmont, Blue Ridge, and Coastal Plain populations. Population sex ratios were biased towards males at many sites, and skewed towards adults. We are currently in the process of comparing surrounding land use data with population demographics to identify land use practices that impact box turtle populations across the state. These data will provide useful benchmarks for comparison to other sites across the range of T. carolina and will allow comparisons to the same site over time as the BTC continues. Land managers and policy makers can use these data to update the status of T. carolina and to make localized decisions on conservation and management to maintain stable or growing turtle populations.

P223 - Preliminary Study of Culturable Bacteria from the Mouths of Individuals from the Family Natricinae in Northern Alabama

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Many species of water snakes in the family Natricinae can be found in the waterways of Northern Alabama. Two common genera of water snake include *Nerodia spp.* and *Regina sp.*, each seem to express different behavioral responses to being handled. *Nerodia spp.* tend to be foul-tempered, are quick to bite, commonly musk, and express other defensive mechanisms. *Regina sp.* tend to be subdued, are more accepting of being handled, with little to no reports of bites or other aggressive

defensive mechanisms. Anecdotally, water snakes are said to have "dirty" mouths that will cause a major infection to anyone bitten by them. This thought is derived from the thought that the waterways they inhabit are full of harmful bacteria. However, in practice we have seen that only minor skin irritation is a result of being bitten by a *Nerodia spp.* Irritation can be explained by the properties of the proteins commonly found in water snake saliva; itchiness diminishes within a short time period after bite. Bacteria load was used to attempt to quantify how "dirty" the mouth of a water snake can be. For a preliminary study, mouth swabs were taken from an individual *Nerodia sp.* and an individual Regina sp. The samples were cultured on Agar plates at two different incubation temperatures, 35°C and 25°C. At the higher temperature a single type of colony was seen on both plates, but the plate from the *Nerodia sp.* had more colony growth. At the lower temperature a single colony type was seen on the plate from the *Nerodia sp.* with more growth than at the higher temperature. The plate from the *Regina sp.* showed multiple colony types at the lower temperature and more colony growth. Future study will include Gram staining to identify different colonies and taking samples from more individuals.

P224 - Cryopreservation and hormonal induction of spermic urine in a novel species: the smooth-sided toad (Rhaebo guttatus)

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Global amphibian declines have fueled an increased interest in amphibian assisted reproductive technologies. Within the genus *Rhaebo*, half of the species are experiencing decreasing population trends; however, insufficient information is available on many of these species' reproductive biology. Using the smooth-sided toad, *Rhaebo guttatus*, we present effective methods for collecting and cryopreserving *Rhaebo* sperm. Specifically, our findings show that administering 10 IU/ g body weight of hCG (human chorionic gonadotropin) yields the most motile and concentration sperm and that cryopreserving spermic urine in a solution of 5% DMFA (N,N-Dimethylformamide) and 10% trehalose returns sperm with a 33 ± 3 % average post-thaw motility. These findings are an important step forward in developing techniques that can be safely applied to other, more vulnerable species within the *Rhaebo* genus.

P225 - Color cues: Does body coloration signal quality in male green frogs?

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The possible significance of body coloration to intraspecific communication in anurans has been little investigated, partly due to the assumption that visual signals are ineffective at night when frog activity generally peaks. However, frogs have acute color vision under low light settings, suggesting a potentially substantial role for visual signaling in social communication in anurans. The green frog (*Lithobates clamitans*) is a sexually dimorphic species of ranid common to freshwater aquatic environments in the eastern US. Adult green frogs of both sexes exhibit a greenish brown dorsal color with irregular black splotches; however, males express bright yellow throats whereas females have white throats. We investigated the significance of this and other color features by examining the extent to which variation in male body coloration is correlated with that of morphological traits linked to fitness in anurans. Both adult male (N=13) and female (N=4) green frogs were captured from ponds in central Georgia. Using a spectrophotometer, we measured coloration of the throat, dorsal abdomen, and ventral abdomen of each frog, and then measured a series of key morphometric features, including body length, mass, forearm length, forearm width, and dimensions of head size. Regression analysis was used to test for relationships between key chromatic variables of each body region in males with SVL, body condition (BCI), head size, forearm length, and maximum forearm diameter. Variation in throat and dorsal abdominal color did not predict variation in any male morphological trait; however male ventral abdominal hue did predict BCI. This suggests that male ventral abdominal coloration could play a role in sexual signaling, though the possible importance of throat color remains unclear. Overall, these results suggest that color could signal body condition in male green frogs, opening the door for future work investigating female preference for males on the basis of body color.

P226 - Utilization of Frog Calls and Visual Cues to Survey the Frogs of the Jacksonville University Campus

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Frogs have been steadily declining worldwide over the last 20 years. One of the major causes of this decline is urban sprawl and habitat destruction. However, isolated pockets of protected land areas, such as parks and large University Campuses, can provide a safe haven where frogs can survive. This study surveyed the frog population present on the Jacksonville University (Jacksonville, Florida) campus using frog calls and visual sightings as evidence of presence. Researchers performed 5 minute point counts at all suitable habitats within the campus boundary, concentrating on ponds and wetland areas. Point counts were performed 1 hour after sunset, for one hour, such that each location had 4 counts per night. This study was performed for 2 weeks during the fall season and serves as the first baseline survey of the campus. Total species counts and relative abundances of each species will be discussed. This survey will continue to include Spring and Summer sampling in the coming year.

P227 - Using trail cameras to monitor seasonal migrations of two pond-breeding salamander species

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Phenology, or the timing of life history events, can be influenced by abiotic factors including rainfall, temperature, and photoperiod. In amphibian communities, the timing of breeding events and arrival order of species can directly influence food web interactions and ultimately whole pond community structure. To better understand the variability of arrival times, we monitored breeding phenology of two fall-breeding salamander species, the Marbled Salamander (*Ambystoma opacum)* and the Ringed Salamander (*Ambystoma annulatum*). We used two drift fences to partially enclose approximately 50% of three wetlands in central Missouri; each fence had an entry point with a wildlife trail camera mounted above to capture photos of adult salamanders moving into and out of wetlands. Cameras were set to capture images based on a motion trigger and a timelapse, with recordings every minute between 20:00-06:00 from 9/3/2017 - 11/17/2017, and 9/6/2018-11/01/2018, encompassing the typical movement period during breeding events for these species. Through the fall of 2017, we captured images of 37 *A. opacum* and 139 *A. annulatum* migrating to or from wetlands, with major breeding pulses occurring on 9/17/17-9/18/17 and 10/3/17-10/6/17. Additionally, we captured images of 17 other species of herpetofauna and 11 species of non-herpetofauna, suggesting that camera traps may be a useful and non-invasive tool for monitoring movements of amphibians as well as predator presence at wetlands. The data presented here are the first two years of an ongoing monitoring project. We will continue to gather information on the effectiveness of trail cameras to monitor amphibian phenology.

P228 - An Examination of Arboreal Habitat Selection by the Green Salamander (Aneides aeneus)

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The Green Salamander, *Aneides aeneus,* is a partially arboreal cliff specialist distributed from southwest Pennsylvania into Alabama and Mississippi along the Appalachian Mountains, with special protected status in several states. Since 2014, we have been involved in an ongoing effort to examine habitat associations in this species at a heavily-populated site at Flag Rock Recreation Area in Norton, Virginia. We recently expanded this research effort to determine the extent and nature of arboreal habitat selection in Green Salamanders, an aspect of habitat use in this species that has received little study. We surveyed rock crevices and surrounding trees for Green Salamanders during weekly visits to this site to determine which arboreal habitats were occupied by the species. In addition, we characterized the following variables that may be drivers of arboreal habitat use at 15 trees with confirmed Green Salamander occupancy and 15 randomly-selected trees at the same site:

number of available refugia (crevices in bark, hollow limbs), distance to rock outcrop, tree size (diameter at breast height), canopy cover, tree height, and litter depth surrounding each tree's base. We hypothesized that Green Salamanders are non-randomly selecting arboreal habitat in response to specific tree attributes. An analysis of similarity indicated that there was a significant difference in occupied trees versus randomly-selected trees, with occupied trees having a larger number of available refugia present. Future research should explore additional factors that may be related to connections between the use of rock crevices and arboreal refugia by Green Salamanders and if specific tree species may be predisposed to the development of available arboreal refugia.

P229 - The relationship between zooplankton assemblages and predatory salamanders in ponds of the central Ozarks, Missouri

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Zooplankton are ubiquitous primary and secondary consumers in many freshwater ecosystems. They can reach high densities in natural ponds with excess nutrients but can be limited when water temperatures or pH fluctuate. One of the largest sources of mortality for zooplankton is predation by fish or other aquatic predators. In many fishless wetlands, the Eastern Newt (*Notophthalmus viridescens*) is the most abundant predator. Both the larvae and adults are aquatic carnivores that feed opportunistically on wetland taxa (i.e. zooplankton and tadpoles). Newts are known to be size-selective predators that can have keystone effects on wetland community structure. Along with newts, ambstomatid salamander larvae (*Ambystoma annulatum, Ambystoma maculatum*, *Ambystoma opacum*) are also important intermediate predators in wetland food webs. To understand how newt and salamander abundance affected zooplankton communities, we sampled 22 ponds in the central Ozarks (Fort Leonard Wood, Missouri) three times during the spring of 2018. Minnow traps were deployed for two consecutive days with trap number scaled relative to the surface are of each wetland. We sampled zooplankton communities using a Nunez water column sampler to take four water samples per pond, one in each cardinal direction one meter from shore. Zooplankton samples were filtered through a 45µm mesh filter and preserved in 70% EtoH. A 10ml subsample was taken from each 70ml zooplankton sample for counting, identification, and body length measurements. Preliminary analyses across all wetlands indicate that higher newt densities in early spring were related to lower total zooplankton abundance. Larval ambystomatid densities were not significantly related to zooplankton abundance. Our preliminary results indicate that newts are likely the driving force behind zooplankton biomass in central Ozark wetlands. Further data analysis on zooplankton size structure and diversity will elucidate on any potential keystone effects of salamanders, as well as how zooplankton composition changes over time.

P230 - Searching for salamanders: confirming the presence of two uncommon species on Northern Shenandoah Mountain

Jack Doss

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Plethodon punctatus is species of lungless salamanders (Plethodontidae) that occurs on Shenandoah Mountain in Virginia and West Virginia. *P. punctatus* is considered to be a habitat specialist, and as such is limited to a narrow distribution. The USDA Forest Service has slated a Restoration and Management Project for Northern Shenandoah Mountain. While the Forest Service is aware of the sensitive nature and limited range of *P. punctatus*, and has protections in place to prevent habitat disturbance, it is unknown whether specific working sites occur in areas where *P. punctatus* is present. Areas containing potential *P. punctatus* habitat were selected on a map of the working sites and were investigated with daytime surveys to determine habitat suitability, as well as to search for individuals. Habitat areas were delineated with GPS markers. If individuals were found, or if the location was deemed unsuitable, no further action was taken. If the location was deemed suitable but no individuals were found, additional night time surveys in favorable weather conditions were performed. *Plethodon Virginia* is less habitat specific but is also limited in its distribution so the presence of this species was also recorded. A total of 28 *P. virginia* and 43 *P. punctatus* were recorded across 16 sites. An inventory including *P. punctatus* and *P. virginia* locations, as well as any other herpetofauna found, were relayed to the Forest Service. From this information modifications to

working areas, such as buffers around known habitat, could be made in order to avoid habitat disturbance.

P231 - Conservation and Management of Eastern Hellbenders (Cryptobranchus alleganiensis) in West Virginia

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Eastern Hellbenders are large, long-lived aquatic salamanders and are current candidates for listing under the Endangered Species Act. As part of a multi-state conservation and management effort, this research will focus on 12 streams in West Virginia known to have historic hellbender populations. I will conduct status assessment surveys through physical and eDNA collection, monitor pathogen prevalence, analyze habitat, and produce nest boxes to supplement natural habitat. Furthermore, I will perform a reintroduction study, using radio telemetry to track individuals. By comparing this study's data to previous research, we will gain a clearer picture of status and trends, which will aid the development of appropriate management plans.

P232 - Genealogical history and admixture proportion of tiger salamanders in Black Lake, Mono County, California.

Ivy Irihamye, Jarrett Johnson

Western Kentucky University, Bowling Green, KY

Since the mid 1950s, introduced populations of western tiger salamanders (*Ambystoma mavortium*) have hybridized with the native, endangered California tiger salamander (*A. californiense*). Hybridization poses a threat to the persistence of California tiger salamanders across a large portion of their range. Therefore, non-hybridized, California tiger salamander populations are often managed to prevent hybridization, and hybridized populations showing genetic admixture with western tiger salamanders are often managed with a goal to decrease the proportion of non-native genes. In the rare case when non-hybridized introduced western tiger salamander populations are found, one option is to implement an eradication strategy. In this study, our objective was to ascertain the status of a newly discovered tiger salamander population, and determine genetically which of the three categories (native, hybrid, or introduced) exemplifies this population. Due to the location of the population outside of the known natural range of the California tiger salamander, we predicted that this population would be comprised of individuals with non-native genomes. We assessed admixture proportions (i.e., genomic ancestry percentages) using DNA sequences for one mitochondrial and several nuclear genes. For the mitochondrial data, we placed our samples into an existing phylogenetic tree comprising other hybridized and non-hybridized introduced populations in California. For the nuclear sequence data, we used diagnostic (i.e., ancestry-informative) single nucleotide polymorphisms to assess ancestry patterns. Preliminary findings support the hypothesis that this population should be categorized as a non-admixed introduced population and may be managed to reduce the risk of future hybridization with California tiger salamanders.

P233 - Identifying Cryptic Lineages within the Northern Dusky Salamander Species Complex Using mtDNA

Kathryn Davis, Nicole Laura, James Davis, David Beamer

Nash Community College, Rocky Mount, NC

The Northern Dusky Salamander (*Desmognathus fuscus*) is a widely distributed species complex ranging from Quebec to Georgia. The populations within this range are currently recognized as a single species, but recent research using mitochondrial DNA sequence data suggests the presence of multiple lineages within populations of *D. fuscus*. These cryptic lineages have been given placeholder names; those that occur in our study area include *fuscus* b, *fuscus* c, and *fuscus* e, as well as *D. planiceps*. We collected ~90 samples of Northern Duskies between northwestern North Carolina and southwestern Virginia along the Blue Ridge Escarpment and adjacent Piedmont. For each of these samples, we extracted DNA and then amplified and sequenced ~650 bp of the mtDNA gene COX1. We aligned the edited sequences, partitioned this dataset by codon position, and selected an appropriate model of nucleotide substitution for each codon. Finally, we analyzed this

partitioned data set in a Bayesian phylogenetic framework. This phylogenetic reconstruction recovers seven monophyletic mitochondrial lineages. Here we focus on recent research in distributional patterns in a region of contact between these newly found lineages.

P234 - Phylogeographic Analysis of Seepage Salamanders (Desmognathus aeneus)

Henri Vega-Bernal, David Beamer

Nash Community College, Rocky Mount, NC

The Seepage salamander is one of North American's tiniest vertebrae (typically less than 60 mm in full body length) and is one of the smallest salamanders in the world. These salamanders are distributed across a large area in the southeastern United States. However, given their small size and physiological makeup, their potential for dispersal is probably limited which provides the opportunity for diversification. We collected DNA sequence data from ~75 populations and ~200 individuals to test whether there is strong genetic structure across their geographic range. Our phylogenetic reconstruction, based on mitochondrial DNA (COX1) recovers six well supported clades. This result presents the possibility that there is more than a single species of Seepage Salamander.

P235 - Meta-Analysis of Eastern Indigo Snake Research over the Last 10 Years

George Cline, Zachary Starr

Jacksonville State University, Jacksonville, AL

The Eastern Indigo snake (*Drymarchon couperi*) is the largest snake in North America and a federally protected species. They inhabit Flordia, parts of Georgia, and a reintroduction program is currently underway in south Alabama. Indigo snakes are one of the many species to utilized gopher tortoise burrows and it has been suggested that they find these burrows by scent. Other chemoreception studies have shown that they prefer the scent of copperheads (*Agkistrodon contortrix*) over any other potential prey item. These and other topics such as life history and home range studies together could help us form a more complete picture of the status of these animals and how best to proceed with conservation. Studies on the Eastern Indigo snake have come out steadily but no literature review has been done on these in at least the last ten years. Here I will synthesize and review all relatively recent studies to determine the state of our knowledge of Indigo snakes and illuminate where our knowledge may be lacking.

P236 - Hybridization between Anuran Hylids in Northeastern Alabama

Andrew Collins, George Cline

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Over the past 60 years, records from Auburn have shown that hybridization can occur between sympatric anuran populations of *Hyla gratiosa* and *Hyla cinerea* in disturbed habitats. It is possible that these hybrids have a reduced fitness level compared to the parent species. At that time, Calhoun County showed a presence of *Hyla gratiosa*, but *Hyla cinerea* had not expanded that far north yet in Alabama. By 2001, *Hyla cinerea* was reported to have successfully invaded Calhoun County. For my own study, I am surveying the Frog Pond Wildlife Preserve in Calhoun County of Alabama as the main undisturbed site of study where both of these species have been reported present. I want to test whether hybridization is occurring in this region of Alabama. I will be using genetic, acoustical, and morphological methods to gather and analyze data in order to identify individuals as well as the characteristics that might be influencing their behavior. Techniques that have proven effective in similar studies as well as newer techniques will be implemented for this project. The undisturbed sympatric population will be compared with a disturbed sympatric population as well as allopatric populations of both species in several locations throughout the species range of northeastern Alabama.

P237 - Impact of Feeding Frequency on Juvenile Growth

Colleen Hoselton, Kinsey Guthrie, Zachary Loughman

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Feeding schedules are an important aspect of any husbandry regime for animals in human care. While frequently debated for endothermic animals, ectotherms, especially snakes, often suffer from stagnated animal husbandry practices. To rectify this issue, we investigated the impact of food presentation frequency, as well as food amount per presentation on the growth of one-year-old and newborn Corn Snakes (*Pantherophis guttatus*) and newborn False Water Cobras (*Hydrodynastes gigas*) in human care. The goal of this study was to test the impact of energy allocation on digestion and determine if the digestion of large meals resulted in a loss of energy allocation for growth. Each snake was fed two prey items representing less than 5% of their mass over a seven-day period of time, though at different frequencies. Three cohorts, each composed of siblings, were split into two treatment groups for the experiment. One treatment group was fed two pinky mice on the same day, while another treatment group was fed one pinky three days apart. The experiment ran for 15 weeks with all animals weighed weekly in grams to determine growth between treatments. Results indicated that there was not a major difference in growth between treatments, suggesting that energy allocated for digesting large amounts of prey did not result in a loss of energy allocation for growth.

P238 - Ecology of Nerodia sipeodon (Common Watersnake) in North Fork Creek, Ohio County, West Virginia.

Elijah Henderson, Dan Meyer, Zachary Loughman

West Liberty University, Dept. of Natural Sciences and Mathematics, West Liberty, WV

The ecology of *Nerodia sipeodon* (Common Water Snake) was studied concurrently with ecology of *Regina septemvittata* (Queen Snake) in North Fork of Short Creek, Ohio County, West Virginia. Snakes were captured via hand collection or aquatic funnel traps. All captured animals were measured, weighed, pit-tagged, and underwent gastric lavage when food boluses were present. Snake activity peaked in the spring, followed by a mid-summer brumation period. Activity reoccurred in mid-August through the fall. Trap captures outnumbered hand captures, though most juvenile animals were collected by hand. Frequently encountered food species included Black Nose Dace, Creek Chubs, and Long Nose Dace. Daily activity peaked in the morning hours, was reduced during the heat of the day, and began again in earnest during the late afternoon and early evening hours. Though concerted effort was undertaken to collect them, zero gravid females were collected with this study. Neonates appeared in the population beginning in late August. The most frequently encountered behavior was basking, followed by various defensive behaviors allied with capture. To date, close to 50 individual snakes have been PIT tagged and released at the study stream. Future efforts will focus on the use of radio telemetry, as well as the capture of gravid females.

P239 - Effects of Water-Related Abiotic Factors on Stream Salamander Abundance

Alanna Horton, Christopher Paradise, Bradley Johnson

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Rapid urbanization worldwide has resulted in substantial levels of ecosystem degradation. Streams and rivers disturbed by urbanization show elevated levels of water contaminants, altered channel morphology, increased flashiness and decreased biodiversity. Stream salamanders, like other freshwater lotic animals, may be susceptible to changes in hydrological variables caused by urbanization. Further, urbanization is likely to have a more pronounced effect in first-order streams where disruption is more direct. In this study, we conducted five stream salamander surveys at 12 first-order streams in the North Carolina Piedmont in the summer of 2016 in order to examine relationships between stream salamander abundance and variables related to urbanization. We determined the relationship between stream salamander abundance and several water-related abiotic factors including daily temperature variation, stream flashiness, dissolved oxygen, and conductivity. We introduce a new variable to describe flashiness in headwater streams, but found that it was not predictive of salamander abundance. We found a highly significant positive relationship between stream dissolved oxygen and salamander abundance. We also found that salamander abundance was higher in streams in drainage basins that had intermediate levels of impervious surface in them, than in drainage basins with high levels of impervious surface and streams with very low levels. Hydrological variables, such as dissolved oxygen and flashiness, are related to levels of urbanization, and can affect the abundance of salamanders in streams. Overall, first-order streams are subject to the undiluted impacts of urbanization and these impacts alter salamander communities. Thus, it is important to mitigate the impacts of urbanization on small stream systems.

P240 - Impact of Long-Term Terrestrial Salamander Mark-Recapture

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Long-term population studies are foundational to our understanding of basic ecological processes and to the evidence-based conservation and management of species. Capture-mark-recapture is a common technique for understanding the population dynamics of species and has yielded important insight into drivers of population growth and vital rates (i.e., survival, recruitment, and immigration). This method involves capturing, restraining, and marking a sample of individuals in a study population. Marked animals are then released and periodically recaptured or re-sighted to understand population demographics. Over time, these survey practices can affect study species directly through interaction with researchers or indirectly through habitat degradation as a result of recurring visits. Most investigations of the long-term studies have focused on the effects of handling stress on captured individuals. There is, however, a lack of studies examining how repeated site visitation can alter species habitat and even affect the population dynamics of study species. Researchers must therefore balance potential impacts with the improved understanding of species ecology and management needs resulting from long-term research. For this study, we performed repeated point count surveys at 142 locations inside and adjacent to 16 long-term capture-mark-recapture plots, first established in 2009, to compare densities of terrestrial salamanders. We found no significant difference in salamander densities between long-term research plots and adjacent control areas (Effect size -5.6 ± 5.8% [Mean ± SD]). These results indicate little or no effect of repeated visual encounter surveys on terrestrial salamander densities, while long-term research in this system has yielded novel insights into the population dynamics and climate sensitivity of this species. Reliable long-term studies are integral to our understanding of ecological processes and to the prudent management of wildlife. Therefore, it is critical that research activities do not needlessly impact study populations.

P242 - Detecting the Presence of cry1aB in infant snacks

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Genetically modified organisms (GMOs) in foods has been a controversial topic that the public has paid close attention to, especially in relation to health and the growth of the children. Nowadays, non-genetically modified organisms (non-GMOs) foods are on demand because of public perception between GMO foods and the presumption that GMOs might have some negative effects on children. According to the United States Department of Agriculture, domestic Bt-corn population has grown from approximately 8 percent in 1997 to 19 percent in 2000, and up to recent year, the amount has climbed up to 82 percentage. Corn has been genetically modified with an insertion of the Cry1Ab gene, which produces an insecticidal resistant ability for the crops. Six corn-based protein snacks including Non-GMO, organic and natural ingredients were tested for the presence of Cry1Ab and Zein. The samples, according to their listed ingredients, do not contain soy, but corn. Those samples include: Happy Baby Organics TeethersOrganic Pea & Spinach, Sprout Toddler Snacks, NurturMe Yum-a-Roo's Toddler Snacks Sweet Corn, Little Journey Little Munchers Cheese, Gerber Lil' Crunchies, Kids Organic Whole Grain Bars Quaker, and Annie's Organic Friends Bunny Grahams Snacks Baked Graham Snacks were prepared and tested for the presence of Cry1ab. If the samples tested yield a positive result for the presence of Cry1Ab toxins, then it is possible that both organic and non-GMO labelled snacks may have GM ingredients present. Therefore, this experiment would bring more awareness to the public perception on product labels and their accuracy. Inaccurate labeling of the ingredient could be a critical act which might cause health issue and ability to grow in children.

P243 - Comparing extranuclear localizations of histone H3 in two human cancer cell lines

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Mitochondria are mostly known as being the main energy producer of a cell. However, mitochondria also play a role in other cell functions such as apoptosis and cell death. Mitochondria are also known to possess their own DNA. Previous studies have presented evidence that histone H3, one of the core histones present in nucleosomes, might not only be present in the cell nucleus but also in the mitochondria of cells. Given the role of mitochondria in initiating the caspase cascade, we initially proposed that stress conditions could be the trigger for H3 translocation from nuclei into the mitochondria. However, recent western blot studies performed using nuclear and mitochondrial fractions of Jurkat cancer cells showed that H3 is present in the mitochondria of both stressed and unstressed cells. The purpose of the present study was to further explore the proposed translocation of histone H3 into the mitochondria using a double immunofluorescent technique to demonstrate co-localization of H3 and Cox-1, a mitochondrial cell marker, in Jurkat cells (Human Leukemia cells) and MCF-7 Cells (Human epithelial cells). Polyclonal antibodies that target the C-terminus of H3 and the N-terminus of Cox-1 followed by fluorescently labelled secondary antibodies allowed the proper identification of the proteins using a confocal microscope. Comparisons of the results obtained with both cell lines showed differences in the extranuclear localizations of histone H3 in the two cell types. Future studies will explore the possibility that genetic mutation variations among different cancer cell types might influence the translocation of histone H3 to different areas outside the nucleus.

P244 - Cannabidiol (CBD) does not protect against an in-vitro model of hypoxia in rat neuronal cells.

Jake Dunn, Michael Grider

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Ischemic strokes are the third leading cause of death in the United States. However, there is currently no FDA-approved drug to promote neuroprotection following injury. Recent studies have identified potential neuroprotective effects of cannabidiol (CBD), a non-psychoactive cannabinoid from the cannabis sativa plant, in neonatal pig models of hypoxia. However, CBD-mediated neuroprotection in animal models may be mediated by CBD metabolites or by interactions of CBD with the vasculature, immune system, or glial cells. In the current experiments, we investigate the ability of CBD to protect against a hypoxic insult in a pure neuronal population utilizing the neuronal cell lines RN33B and PC12. Concurrent with a 24-hour injury, cells are exposed to varying concentrations of CBD or a vehicle control. Neuronal viability is measured using an LDH assay. We found that CBD did not protect against the injury and, at higher concentrations, may be neurotoxic itself. Further studies are required to elucidate the mechanisms of potential CBD-mediated neuroprotection.

P245 - Microglial mediated anti-inflammatory properties of nicotine on dopaminergic neurons

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Microglia are the primary immune cells in the brain which function like macrophages and undergo phagocytosis. In diseases such as Alzheimer's and Parkinson's, inflammation in the brain can sometimes cause microglial cells to function improperly, resulting in failure to remove plaque-causing agents from neurons. As nicotine has shown certain neuro-protective effects it is in question as to whether it could have a positive effect on microglia, and subsequently on neurons under inflammatory conditions. To better understand the effects of nicotine and other potentially neuro-protective compounds on microglial and neuronal cell health, BV2 microglial and MN9D dopaminergic cell lines were studied. In the target-transfer assay, BV2 cells were pretreated with nicotine and LPS. Conditioned media from BV2 cells was transferred to MN9D cells, which were then studied via cell viability assays. Preliminary results revealed that BV2 microglia may be playing a role in mediating nicotine's anti-inflammatory effects. These findings highlight the importance of microglia in maintaining healthy conditions for neuronal cell function.

P246 - Transformation of Marine Dinoflagellates to Shed Light on Bioluminescence

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Dinoflagellates are planktonic eukaryotes abundant in many aquatic habitats. While these organisms are ecologically relevant and several species are well known for their negative impact on human health through production of toxins, there are few examples of genetic manipulation with these organisms. Such work however, could improve our understanding of their physiology and population dynamics. Three main challenges obstruct genetic manipulation in dinoflagellates; the large genome size which has prevented genome sequencing of any free-living species, the presence of a cell wall, and slow growth rate. Here, we have leveraged components of previously published work in other systems and one previous study with dinoflagellates to develop a protocol for transformation and creation of a mutant library using the bioluminescent marine dinoflagellate, *Pyrocystis lunula*. Our system for transformation is currently being used to identify proteins involved in the signaling pathway for bioluminescence. We are particularly interested in the mechanoreceptor involved in initiation of the pathway as this class of cell receptors is relatively poorly characterized compared to chemoreceptors. Dinoflagellate bioluminescence provides an avenue for exploring this class of receptors. To our knowledge, we have created the first mutant library of dinoflagellates using a plasmid with a Green Fluorescence Protein reporter gene and this approach is likely to yield new insight into dinoflagellate physiology and into the signaling pathway for bioluminescence.

P247 - Cost Effective Strategies for Supplementing Cell Culture Media in an Undergraduate Teaching Laboratory

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Supplementation of in vitro cell cultures with Fetal Bovine Serum (FBS) is customary in most cell culture applications. Currently in the Cell Biology laboratory at Georgia Gwinnett College (GGC), students analyze the growth of mammalian PTK2 (*Potorous tridactylus* epithelial kidney cells) cells in response to a chosen experimental factor over the course of the semester. To decrease the cost of generating cell culture media for this semester long research project, we explored various FBS alternatives that were less expensive than what was previously used. We compared the growth of PTK2 cells supplemented with the current FBS to those supplemented with the FBS alternatives. Once we found a less expensive FBS that supported cell growth, we continued efforts to decrease the cost by testing different concentrations of FBS in the cell culture media. Our results allow GGC as well as other colleges and universities to acquire more cost-effective alternatives of FBS that can be used in undergraduate teaching laboratories.

P248 - Evaluating candidate genes involved in extrafloral nectary development in Passiflora with in situ hybridization

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Passiflora, commonly known as passionfruit or passionflowers, is comprised of ca. 650 species of vines, lianas, and small trees found in the New and Old World tropics. This group of plants is well-known for the complex interactions it has with pollinators, herbivores, and bodyguard insects. *Passiflora* exhibits the highest diversity in leaf shape in all of the angiosperms. Moreover, these leaves are covered with a diverse array of extrafloral nectaries (EFNs) found on the margins, laminar surface, petiole, and stipules. EFNs have played an important role in the evolution of the genus, yet little is known about the genetic mechanisms that are responsible for their presence, form, and patterning on the leaf itself. To identify genes involved in EFN morphogenesis, a comparative transcriptomic study was performed to identify candidate genes with significant differential expression in EFN structures. In the present study, gene expression patterns in four of these candidate genes, *SHI*, *B3-1*, *B3-2*, and *NAC,* are examined in *Passiflora morifolia* and *P. boenderi*. Preliminary real-time qPCR data obtained from young leaves suggests that both SHI and NAC have direct roles in EFN morphogenesis, while *B3-1* and *B3-2* are involved in leaf margin specification. This work was completed on young leaves where EFNs were already visible. To fully examine the role of these genes in morphogenesis of EFNs, in situ hybridization experiments are being performed on shoot tips where leaf primordia are initiating. This work will provide new insights into the roles of these genes in EFN tissue differentiation at the earliest stages of development, providing a fuller picture of the genetic mechanisms behind EFN organogenesis in *Passiflora*.

P249 - The effects of chemical and biological gold nanoparticles on human dermal fibroblasts

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Nanoparticles have diverse applications such as drug delivery mechanisms, cosmetics, skin care products, and industrial construction; however, harsh chemicals are used for their synthesis. Cytotoxicity of these nanoparticles has adverse effects for its use in biomedical applications. Biological synthesis of nanoparticles has a reduced cytotoxicity relative to chemical synthesis. Therefore, gold nanoparticles (AuNPs) were synthesized with 0.5 mM $HAuCl_4 \cdot 3H_2O$ using *Camellia sinensis* (black tea) as a reducing agent. We explored the concentration dependent cytotoxic effects of biogenic AuNPs and chemically synthesized citrate-capped AuNPs. The crystallinity, size, and charge of the nanoparticles in suspension were analyzed by high-resolution transmission electron microscopy (HR-TEM) and dynamic light scattering. After characterizing the biogenic and chemically synthesized AuNPs, we analyzed their effects of concentration and exposure time on human dermal fibroblast (HDF) cells. Immunofluorescence microscopy was performed using phalloidin and 4, 6 Diamidine-2-phenylindole dihydrochloride (DAPI) to analyze their effects on the actin filaments and nuclei of HDF cells. We also assessed the cell proliferation and viability using MTT and LDH assays. The MTT and LDH results showed that the cytotoxic effects were similar for biological and chemical AuNPs, and at 72 hours of exposure, both AuNPs caused an increase in cell growth. We further studied apoptosis by flow cytometry and observed that there was an increase in the number of live cells after 72 hours of exposure to both chemical and biological AuNPs. Overall, we have shown that there is no significant difference in the toxicity of biological and chemical AuNPs. Anionic nanoparticles are known to interact less favorably with cells membranes. Hence, we will further substantiate the results by zeta potential analysis of AuNP charge and ICP-MS analysis to quantify uptake of AuNPs. Additionally, we will be comparing the toxicity using functionalized AuNPs to investigate the dual nature of the citrate-capped and biological AuNPs.

P250 - Conservation of Histone H3 Binding to Mitochondria Across Eukaryotes

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Mammalian histones have long been reported to bind to mitochondria and cause the release of Cytochrome C into the cytoplasm. Cytochrome C release is correlated with programmed cell death in a wide range of eukaryotes. Preliminary evidence indicates that histone H3 can bind to mitochondria in both cauliflower and yeast and furthermore, histone enriched fractions cause Cytochrome C release in both cauliflower and yeast. We hypothesize that histone-mitochondrial interaction may be broadly conserved across divergent eukaryotes. The objectives of our studies are to determine by cross-incubation studies whether histones from one organism have the ability to bind to mitochondria from another organism while indicating a conserved interaction and binding mechanism--for example, cauliflower histones binding to yeast mitochondria and vice versa. Our studies also aim to determine salt concentrations causing histones to be stripped away from mitochondria, providing a crude indication of the affinity of histone binding. In the presence of high salt concentrations, mammalian histones continue to bind to both cauliflower and yeast mitochondria. This reveals that the histones are bound tightly to the mitochondria, because high salt concentrations typically disrupt binding processes. The histone H3 binds to cauliflower mitochondria at a salt concentration as high as 0.8M and to yeast mitochondria at a salt concentration of 0.5M. Cauliflower histone H3 binds to yeast mitochondria and can withstand a salt concentration of 0.5M, this indicates that they can resist a high salt concentration before unbinding and reveals a highly conserved mechanism given that the histones of different species can bind together. Histone H3 binding to mitochondria is shared between eukaryotes and is either a strong bind to receptors or H3 is taken inside the mitochondria.

P251 - Adhesive Organs in Turbellaria: Result from Freshwater Species

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Meiofauna comprise animals living in aquatic sediments that are small enough to move between sediment grains. Marine forms often possess duo-gland adhesive organs, in which one gland cell

(viscid gland) secretes a glue, and the second gland cell (releasing gland) purportedly secretes a releasing substance. Duo-gland organs allow the animal to attach reversibly to sediment grains and are clearly necessary for organisms that constantly are exposed to wave and current action. In the past decade, substantial progress has been made in identifying and characterizing viscid secretions at the molecular/genetic level in marine flatworms, and formulating a functional hypothesis for attachment and release. Additionally, it has been demonstrated that the lectin Peanut Agglutinin (PNA) specifically labels viscid gland secretions in the marine flatworm *Macrostomum lignano*. Duo-gland adhesive organs are common in marine species; however, less is known about adhesion in freshwater flatworms. A putative duo-gland adhesive system has been identified by transmission electron microscopy in a member of the genus *Prorhynchus,* and lectin-staining results have been reported for the marginal adhesive glands in *Schmidtea mediterranea*. Here, we report on fluorescent lectin staining of putative adhesive glands in three species of freshwater flatworms (*Prorhynchus* sp., *Procotyla cf. typhlops*, and *Ascophora cf. elegantissima*). *Support for this project was provided from grant P20GM103499 (SC INBRE) from the National Institute of General Medical Sciences, National Institutes of Health*

P252 - Nicotine effects on human cardiac microvascular endothelial cell viability

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Human cardiac microvascular endothelial cells (HCMEC) regulate blood flow and capillary exchange in cardiac myocytes. Medical conditions associated with endothelial malfunction include the following: hypertrophy, ischemia, hypertension, and diabetes. Previous research indicates that nicotine causes apoptosis, also known as programmed cell death, in rat cardiac myocytes. Our hypothesis was that nicotine causes similar effects in cardiac vascular endothelial cells. We cultured HCMEC isolated from heart ventricles with nicotine or saline for 24 hours. Nicotine appeared to reduce cell number compared to saline control. Similar data were obtained in cultured human cardiac myocytes. In conclusion, our results suggest that nicotine induces cell death in cardiac myocytes and endothelial cells. Pilot p53 protein expression data will be presented.

P253 - Utilizing HPLC to Determining Levels of Short Chain Fatty Acids (SCFAs) in Shigella flexneri 2a Strain (ATCC 29903) Grown In-Vitro.

Jeremy Paradice, Jessica Wade, Kingsley Dunkley

Abraham Baldwin Agricultural College, Tifton, GA

The objective of this study was to employ the use of HPLC to determine various levels of short chain fatty acids (SCFAs) metabolized by *Shigella flexneri* 2a strain (ATCC 29903) grown in LB broth. *S. Flexneri* is a gram negative enterobacteria that proliferates in the intestinal epithelium of host organisms and is responsible for over 1.1 million deaths per year. *S. flexneri* produce SCFAs as byproducts of respiration, these include acetic, propionic, butyric and formic acids which are 1-4 carbons long. SCFAs synthesis differs between microorganisms by their unique metabolic pathways, such as the pentose-phosphate pathway and the Entner-Doudoroff pathways. At low pH, SCFAs promote bacteriostatic action by increasing the concentration of undissociated acid, which permeate the cell membrane of bacteria and reduce their capacity to form ATP, hence, replication is compromised. In the current study, cultures were grown in LB broth at a pH 7.5 for 9 hours in which samples were collected at various time points for SCFAs analysis by HPLC. Spectrophotometry was used to establish growth rate via optical density and supernatant was separated from cells via filtration method. The supernatant was then diluted by a 5:1 ratio and then underwent liquid-liquid extraction for HPLC analysis. Our results indicated that acetic, propionic, butyric and formic acids were metabolized in all three phases of *S. flexneri* growth with acetic acid being the most prolific. In addition, our Data may suggest that SCFAs may be responsible for reducing the pH and growth rates of *S. Flexneri in-vitro*.

P254 - Evaluating Glucose Consumption and ATP Yield for Shigella flexneri grown in LB broth

Jessica Wade, Jeremy Paradice, Kingsley Dunkley

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The objective of this research was to measure both glucose and ATP concentrations from *in vitro* growth of *S. flexneri* 2a strain (ATCC 29903). *S. flexneri* is a gram-negative facultative bacterium found within infected foods and water of poorly sanitized environments. Once ingested, the bacterium will enter and invade the colonic epithelia of the large intestine causing severe dysentery. Within the host's cell, *S. flexneri* works to rearrange and utilize the cell's intracellular contents, including glucose and ATP. Utilizing various pathways of glycolysis, this facultative anaerobe can produce ATP in the presence or absence of oxygen. In the absence of oxygen, a mixed-acid fermentation pathway will be utilized to form both ATP and an organic acid. In the current study, *S. flexneri* (ATCC 29903) was grown in LB broth with 0.3% glucose. At various time points (between 0-9 hrs.) samples were extracted and filtered to obtain supernatant for glucose analysis. Glucose absorption levels were measured using the Glucose Micro-titer Auto-kit. Samples for ATP detection were centrifuged to separate and re-suspend cells into 0.9% saline solution. ATP absorption levels were determined using the ATP Detection Assay Kit via luminescence. Results indicated that after three hours of incubation, glucose levels decreased gradually, suggesting that *in vitro* growth of *S. flexneri* may rely on the presence of glucose. The results indicated that the change in ATP levels and consumption of glucose were highly correlated.

P255 - The Effect of Receptor for Advanced Glycation End Products on Cancer Metastasis

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The Receptor for Advanced Glycation End-Products or RAGE is a pattern recognition receptor that is involved in many inflammatory diseases including cancer. In breast cancer, RAGE expression has been correlated with metastasis and poorer outcomes. Studies in rodent models by our lab and others have shown RAGE drives tumor progression and metastasis. However, further understanding of the tumor cell biology that RAGE affects in metastasis is needed. Here we hypothesize that RAGE drives breast cancer cell migration, and that by targeting RAGE at both the gene and protein level we can reduce tumor cell migration. We first performed western blot assays to confirm RAGE protein levels in the RAGE shRNA knock-down cell lines and compared it to their scramble shRNA controls. Functional assays have shown that RAGE drives tumor cell migration and invasion; both critical mechanism in tumor metastasis. To perform migration assays, we tested different cell number of E0771 and 4T1 and tested the timing and confluence of the cells over 24-48 hours. Once cell numbers were determined we performed high-throughput analysis of the cell migration using the IncuCyte WoundMaker. We are currently performing experiments with various cell lines with RAGE shRNA gene knock-down versus controls. In conclusion, we have optimized a novel high-throughput system for testing the role of RAGE in tumor cell migration. These studies have the potential to impact the development of RAGE drugs to inhibit tumor progression and metastasis.

P256 - Utilization of Immunoassay and SDS-PAGE to Analyze Myosin-Light-Chain in Predominant Meat Species in Southeastern USA

David Howell, Kingsley Dunkley

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The objective of this study was to compare myosin-light-chain in muscles of various species of meat animals. Variation in muscle fiber among organisms may occur due to factors such as nutrition, genetic mutation and environmental factors. There is a wide range of muscle fiber in animals with specific functionality, actin thin filament and myosin thick filament function in contractile motion of the sarcomeres while proteins such as troponin and tropomyosin regulate the motion by blocking ATP binding sites. Other proteins function as attachment such as titin, nebulin, and alpha-actin. Up to 50% of skeletal muscle is composed of myosin protein which has a three-dimensional structure composed of six sub-units, two heavy chains with masses of 200kD, and four light chains with masses ranging from 15-25kD. In the current study Laemmli sample buffer was used to extract protein fibers from five species of meat animals, then muscles were separated via SDS-PAGE. Bands were then transferred to nitrocellulose paper through western blotting procedure after which immunoassay was used to identify myosin light chain in all samples. Our results revealed that the relative intensity of myosin-light-chain was conserved despite the differences in species of meat animals, showing all bands between 22-25kD ranges with relatively equal intensity of bands by the colorimetric enzyme detection indicator.

P257 - An examination of the microbiome of bat feces from a White Nose Syndrome positive site.

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University of Tennessee at Martin, Martin, TN

White nose syndrome (WNS), an emergent disease caused by the fungus *Pseudogymnoascus destructans* (*Pd*), has been decimating populations of hibernating bats for the last decade in Tennessee. Although several studies have compared the relationship between the skin microbiome of bats with or without WNS, relatively fewer studies characterize the gut microbiome of bats from WNS affected areas. The intestinal microbiome of bats in areas with *Pd* might be correlated with population level characteristics that increase or decrease the likelihood of infection by *Pd*. We isolated bacterial DNA from bat feces from a WNS positive habitat and characterized the gut microbiota of bats using NGS in this study.

P258 - A quantitative analysis of Pseudogymnoascus destructans in bat feces from a White Nose Syndrome positive site

Kellas Ujcich, James Smart, Nancy Buschhaus

University of Tennessee at Martin, Martin, TN

The fungus *Pseudogymnoascus destructans* (Pd) causes the disease White Nose Syndrome (WNS) that has led to enormous population declines of hibernating bats over the last decade in Tennessee. We isolated Pd DNA from bat feces from a WNS positive habitatover a 3 month period and used QPCR to examine the relative spore load. The amount of the Pd fungus in the feces of bats in areas with Pd might be correlated with population level characteristics. Therefore, being able to measure the level of Pd in a non-invasive way may be important for the management of bats.

P259 - Thermal Range Specialization in Tropical Bees: Implications for Climate Change

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Plant-pollinator relationships provide a critical ecosystem service. Plants depend on pollinators to set seed and reproduce, and many animal populations rely on the resources provided by flowering plants, such as nectar and pollen. There is an urgent need to document thermal range tolerances and thermal specialization in tropical bee assemblages to understand how these important pollinators may respond to warming temperatures, as tropical ectotherms have been predicted to be the most vulnerable group to warming temperatures. Our study aims to predict patterns of elevation range and peak abundance in tropical bee communities using empirical data for bees in the Tribe Ceratinini. Bees in the Ceratinini Tribe can serve as a model representing the bee community, as members of this tribe span a variety of sizes and functional groups. Three replicate elevational transects spanning 800 to 1100 m in the seasonally dry Pacific slope forests of Costa Rica were established for the study. Multi-year data (2012-2019), obtained using bee bowls, vane traps, and by hand collecting, were analyzed to quantify the elevation band where peak abundance occurs for eight Ceratinini species. A distance-based redundancy analysis indicates that elevation explains 23% of the variation in Ceratinini community composition for bees collected between 800 and 1100 m elevation. The two most abundant species, *Ceratina trimaculata* and *C. rectangulifera*, with over 2,500 individuals collected, both display a high degree of thermal range specialization, with *C. rectangulifera's* peak at lower elevations (800-900m elevation) and *C. trimaculata's* peak at higher elevations (1100m elevation). The less common and larger Ceratinini species also show thermal range specialization but more individuals will need to be collected before these patterns can be statistically verified.

P260 - The effect of a thermal gradient on age and growth characteristics of Largemouth Bass (Micropterus salmoides)

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Climate change has become a growing concern in the world of environmental research. Climate change can refer to any number of different statistical changes in weather patterns, but temperature change is a key component of climate change. These global temperature changes can have a large impact on species whose characteristics are thermally dependent. Our goal is to examine the relationships between mean annual temperature and variation in Largemouth Bass (*Micropterus salmoides*) longevity and size at age 3. We expect Largemouth Bass to live longer but grow smaller in cooler temperatures than in warmer temperatures. Previously published data on this species has been collected from across the United States and Canada. Our preliminary results show there is a significant negative relationship between latitude and total length at age 3 as has been previously reported in the literature. There is no relationship using least squares regression between latitude and longevity; however, the data are arranged in a vertical parabola that opens upward. Nonlinear relationships between temperature and longevity have been previously reported in other taxa, such as the pikes, *Esox*. Using a high-resolution temperature dataset developed for climatological research, we will perform an analyses based on measured temperature and compare that analysis to the latitudinal analysis. This study aims to explore the effects of temperature changes on Largemouth Bass in order to determine the future possible effects that climate change will have on this species.

P261 - Using physiological conditions to assess patterns of Subarctic wood frog (Rana sylvatica) habitat suitability

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Arctic regions are especially susceptible to the effects of climate change, with surface warming rates up to three times greater than the global average. Climate change influences wildlife habitat suitability by altering environmental conditions (e.g. air temperature and moisture availability). Habitat alteration can be particularly impactful for wildlife that are dependent on the environment to meet physiologically requirements. The wood frog (*Rana sylvatica*) is a Subarctic amphibian species that must maintain appropriate water balance conditions in a terrestrial environment. I hypothesize that the evaporative water loss (EWL) rates of *R. sylvatica* will differ among three Subarctic habitat types (tundra, boreal forest, and tundra/forest transition) with water loss rates greatest in the tundra due to increased exposure to environmental variables (e.g. wind and sunlight). I also predict that as a result, tundra will be the least suitable habitat in the Subarctic. To address our hypotheses, we selected four sites within the Subarctic landscape of northern Manitoba. At each site we deployed five plaster models along two randomly located transects within each habitat type. Fully hydrated models were reweighed after a two-hour deployment period to determine EWL rates. Environmental conditions were also measured at model locations. I found that EWL rates are significantly greater in tundra habitat with the lowest EWL rates in the forest habitat. Preliminary analyses also indicated that surface temperature of plaster models, humidity, ground temperature, and wind speed were significant indicators of EWL rates during the summer season. Based on our results, the potential time of wood frog surface activity and habitat suitability will be reduced in tundra habitat. Identifying current patterns of physiological and environmental conditions and habitat suitability should be a priority for wildlife in rapidly changing Subarctic landscapes. Such patterns will help to accurately predict future behavior and range expansion or contraction of Subarctic wildlife.

P262 - Germination of camphor seeds dispersed by American Robins

Natasha Vanderhoff

Jacksonville University, Jacksonville, FL

Non-native plants are spreading across the southeastern U.S. and migratory birds that consume large quantities of fruit during fall migration and winter may exacerbate the problem. We examined the potential for American Robins *Turdus migratorius* to be important dispersers of the non-native invasive camphor *Cinnamomum camphora*. Preliminary data suggests that robins may act as effective dispersers of camphor seeds, as a flock of robins may remove over 2,000 fruits (and their seeds) every hour from a tree. We collected regurgitated and/or defecated seeds ("treated") by robins foraging on camphor and ran germination trials. We expect seeds "treated" by robins to germinate faster than seeds that fall to the ground naturally.

P263 - Effects of ecological light pollution on insect communities

Nicholas DiMassimo, Christopher Paradise

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The natural cycles of light and dark have been altered and disrupted due to the proliferation of artificial light at night (ALAN), and understanding its impacts across organisms, populations, communities of insects is critical, especially given the recent realization that insect populations around the world are declining. We hypothesized that artificial light at night can act as a source of pollution and a powerful force that can alter both the function and structure of local insect communities through a disruption of species interactions. To test this hypothesis, we utilized a UV-light trapping method to assess insect communities at six different Davidson College (Davidson, NC) campus sites, three of which were exposed to ALAN and three of which were unlit at night. We found distinct differences in communities due to the significant effect of lighting on individual insect communities suggesting artificial light can act as a disruptive force. We found that dark sites consistently had 170% more insects than lit sites. In addition, insect activity increased exponentially with temperature in dark sites, while it increased linearly in lit sites. While the limitations in our taxonomic resolution, restricted our conclusions regarding individual species, the capacity of light pollution to alter insect communities could have drastic implications for the stability of ecological systems and, therefore, should become a more prominent focus of ecological research.

P264 - Succession on Black Belt Prairies by Eastern Redcedar Trees

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Prairies occur in the Black Belt region of Mississippi and Alabama at sites where the soils thin over the underlying bedrock. Urban and agricultural development have reduced the area of prairie to less than 1% of its original extent. Many remaining remnant prairies are threatened by ecological succession, led by the invasion of eastern redcedar trees, one of the few species that can grow on the open prairie. The redcedar trees shade out light-demanding prairie species and provide opportunities for other tree species to colonize, eventually leading to the replacement of grasslands with forest. At two sites in east-central Mississippi, we are examining how long this process is taking, how it proceeds, and whether it occurs in the absence of fire. Thirty-four redcedar trees from the two sites, Osborn and Crawford, were cut down and cross-sections were prepared. The number and width of the tree rings were measured on the cross-sections. The oldest trees on the two sites were 90 and 91 years old. The average age was similar as well: 68.8 years at Osborn and 66.9 years at Crawford. Several growth patterns were present at each site. Some of the oldest trees grew fastest when young and slowed in maturity, suggesting that the prairie was filling in with competing trees. However, several trees experienced "releases," where an abrupt but sustained increase in growth was observed. This may indicate that a disturbance occurred, reducing competition. For the most part, releases appeared independent, consistent with small localized events, such as the death of neighboring trees. Only three trees show any evidence of fire damage, suggesting any fires were small and inconsequential. Overall, the invasion of redcedar trees into Black Belt prairies appears to be slower than what has been documented in the Great Plains.

P265 - Floristic indicators of wind, logging, and fire in longleaf pine woodlands

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Plant diversity and community organization are shaped by natural and anthropogenic disturbance agents, each with unique impacts on plant succession and development. The representation of species-specific life-history traits after disturbance reflects how plants survive, colonize, and compete in disturbance-impacted areas. The objective of this study was to assess how prescribed fire influenced plant communities in longleaf pine (*Pinus palustris*) woodlands differentially impacted by an April 2011 EF3 tornado and a subsequent salvage logging operation. A mixed study design was used to monitor the composition, foliar cover, and trait distribution of ground flora before (2016 and 2017) and after (2018) a prescribed fire conducted across mature, wind-disturbed, and salvage-logged sites. Ground flora diversity, which was consistently highest on unlogged wind-disturbed sites, was reduced by salvage-mediated habitat homogenization (i.e. deadwood extraction). Total foliar

cover increased on unlogged and salvaged wind-disturbed sites. However, the foliar cover of forbs, shrubs, and trees was greater on unlogged wind-disturbed sites compared to salvaged sites, which hosted a higher cover of vines, particularly yellow jessamine (*Gelsemium sempervirens*). Although prescribed fire did not facilitate the convergence of disparate ground flora assemblages, the foliar cover of understory trees was reduced after fire, which facilitated increased graminoid and shrub cover in unlogged and salvaged wind-disturbed sites. Additional analyses are ongoing to assess if other plant traits (e.g. life cycle, native status, and location of perennating organs) were associated with particular disturbance combinations. Preliminary results indicate that stand-scale plant diversity can be increased by limiting the extent of salvage logging, and that prescribed fire is effective in promoting growth of understory graminoids and shrubs.

P266 - Drivers of endophyte communities of the invasive plant Kudzu (Pueraria montana var. lobata) in the Southeast United States: toward a framework of integrative plant management

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Plant endophytes, microbes that colonize plant tissues but are asymptomatic, are a hidden world of diversity that plays important roles in plant health and fitness. Kudzu (*Pueraria montana* var. *lobata*) is a highly aggressive invasive that is a dominant weed in the Southeast United States and covers ca. 7,000,000 acres. Despite the adverse impacts of kudzu on ecosystems, including increased ozone pollution, as a reservoir of pathogens for regionally important crops (soybean), alterations in soil biogeochemical cycling, and out-competing native plants, management options are few. Toward a goal of developing management strategy for Kudzu using an endophyte-pathogen framework, we conducted the first investigations on Kudzu endophytes to elucidate the drivers of Kudzu endophytic communities. We interrogated fungal and bacterial endophytic communities (Illumina MiSeq) of Kudzu across the invasive range in the southeast United States (TN, MS, AL, GA) as well collected multiple leaf data including physicochemical (NO_3^-, K^+), leaf trait (leaf surface area, chlorophyll), genetic (genotype), geographic, and pollution (PAHs, vehicular traffic volume) data. We tested hypotheses on the drivers of endophytic community assembly including the roles of host genetics and geographic distribution and the impact of pollution. Microbial communities were diverse and structured by multiple variables (Chlorophyll density, Leaf area, nitrate, potassium, traffic volume, geographic location, and kudzu genotype) in our PERMANOVA analyses, but traffic volume (proxy for pollution) and Kudzu genotype were the strongest drivers of endophytic communities ($F_{4,79}$=4.043, $P<0.001$, R^2=0.126 and $F_{5,79}$=2.901, $P<0.001$, R^2=0.113 respectively). These two factors explained at least 3.5x more community variation than the next strongest factor. Further, OTU richness (S_{obs}) and diversity (1-*D)* estimates changed across geography and with traffic volume. Taken together, these data suggest that host-genetics and local pollution play important roles in structuring Kudzu endophytes and integrative plant management strategies must account for these factors during implementation.

P267 - Distribution and abundance of Nandina domestica and Ligustrum sinense in a Georgia riparian forest

Zoe Nuhfer, James Ferrari

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Nandina domestica is an invasive plant that is common in the Southeastern U.S. and whose fruit is toxic to birds (Woldemeskel and Styer 2010). *Ligustrum sinense* (Chinese privet) is also invasive and common in the region, and has been shown to suppress native plants (Merriam and Feil 2002, Wilcox and Beck 2007). In this study we documented the abundance and distribution of Nandina and Chinese privet in the Wesleyan College Arboretum in central Georgia. In initial observations Nandina populations appeared to be more abundant in riparian habits; therefore we examined the relationship between soil moisture and Nandina abundance. In forty 5x5m plots on transects perpendicular to Wolf Creek, the number and height of Nandina plants was recorded, soil moisture was measured, and elevation relative to the creek was determined. The number of Chinese privet plants in a 1x1m quadrat within each plot was also recorded. Nandina had higher density in areas with high soil moisture, though density was not significantly influenced by other factors. Chinese privet density had a negative relationship with both distance and elevation from the creek.

P268 - Herbaceous layer diversity declines as Microstegium vimineum invades an old growth forest in Eastern Kentucky

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Microstegium vimineum, commonly called Japanese Stiltgrass, is an invasive weed which has become a particularly problematic plant in the Eastern Deciduous forests of North America. This grass is well adapted to growing in the shade in forests and tends to spread by colonizing disturbed areas. *M. vimineum* has been previously reported to alter soil nutrient cycling, modify forest succession, and reduce diversity of plants in the herbaceous layer. We tested to see if *M. vimineum* would have similar effects in Lilley Cornett Woods, an old-growth forest in eastern Kentucky where there have been limited anthropogenic disturbances. To observe the differences in the herbaceous layer between *M. vimineum* invaded areas and uninvaded areas, we used a paired plot design, where one plot with 50% or more *M. vimineum* cover was placed adjacent to a plot with less than 25% *M. vimineum*. Percentage cover of every vascular plant species in each plot was recorded. Soil samples and abiotic conditions such as canopy cover and soil moisture were recorded. We used linear mixed models to fit the responses of herbaceous species richness and Shannon diversity, with likelihood ratio tests to determine the significance of *Microstegium* invasion. Preliminary results suggest that invasion of *M. vimineum* did not alter richness but did alter Shannon diversity in the negative direction. These results indicate that invasive species are threats to native diversity even in the most intact ecological areas.

P269 - Characterizing the microbiome of honey

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On nearly every surface and inside almost every organism, there are millions of tiny microbes that are invisible to the naked eye. Some of these microbes, known as symbionts, live in symbiosis or within other organisms. These tiny microbes include bacteria, fungi, and viruses. Honeybees (*Apis mellifera)*, like most insects, host symbionts in their guts. Previous research has identified and characterized nine bacterial species clusters that dominate the gut microbiome of honeybees. While the microbes in their hives and honey have not been as well characterized, we know that honeybees come into contact with a variety of microbes while foraging. The microbes that are present may depend on the season and region the hives that the honeybees are located in, as well as the gut microbial composition of workers in the hive. We used DNA metabarcoding to assess whether there are regional and/or temporal differences in the symbiotic environment of the guts of worker bees and the symbionts in stored honey. We will also address the following questions: What microbial symbionts are present in honey and how does the season impact that? How are these microbes related to the ones present in the guts of honeybees?

P270 - Avian communities of the tropical dry forests of the Azuero Peninsula, Panama: a comparative study of reforestation type

Tyler Kovacs, Heather Griscom

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Panama possesses one of the most endangered tropical ecosystems on earth. Tropical dry forests have been historically cleared throughout Central America, leaving about 2% of forests intact. In Panama, this unique ecosystem has been nearly eliminated due to cattle ranching. Reforestation efforts of the tropical dry forests range from monoculture plantations to natural regeneration of secondary forests. Avian communities may be responding differently to these reforestation systems, which has implications for their future. In this study, avian communities will be investigated within three reforestation systems in the tropical dry forests of Panama. During the dry season in March 2019, avian communities will be compared within three 15 year old forests with different reforestation strategies (an exotic monoculture of *Tectona grandis*, a mixed native species tree plantation, and a young secondary forest) as well as within a mature secondary forest. Point count surveys will be conducted between 6 and 9 AM for one week along 4 randomly placed transects in each forest type. Data will be collected on bird species richness and dietary guild to compare communities within each

of the four forests. The prediction is that richness will be greatest in the mature forest and secondary forest and mixed native species plantations will be similar in species composition. Fewer bird species are expected in the teak plantations because of limited resources, especially for frugivores. This data will be added to the collaborative PREDICTS database project to increase our understanding of how biodiversity is responding to land-use changes around the globe.

P271 - Analyzing community structure and composition of woody vegetation between riverine landforms in channelized and unchannelized sites

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Floodplain alteration such as river channelization is common in West Tennessee, and studies have confirmed that these modifications can affect the surrounding ecosystem. Previous studies have explored large scale channelization effects, but smaller scale studies have been limited. The purpose of this research was to investigate how river channelization may change surrounding plant community structure. Three riverine landforms (alluvial flat, levee, and backswamp/slough) located across three floodplain sites (two of which had undergone river channelization) in West Tennessee were studied. Altered (channelized) sites were compared with unaltered sites within the same landform type. Three 15x15m plots were established along transects in each site, within which the identification, dbh (if applicable), and height of all woody plants >60cm were determined. Canopy cover was also measured for each plot. Multivariate analyses were used to compare species composition between treatments. Vegetation >5m and <5m tall were analyzed separately. In both size classes, preliminary analysis on vegetation showed differences in composition between some plots within each landform type; but a clear separation between altered and unaltered plots was only evident between the altered backswamp and unaltered slough. Mean richness/plot was not significantly different between sites for vegetation in either size class, but the backswamp and slough had the fewest species. Canopy cover was significantly higher in the unaltered levee compared to the channelized levee, but only one channelized alluvial flat had significantly less canopy cover than the unaltered alluvial flat. Differences in plot composition within each landform type was likely related to within-site differences in soil moisture, presence of spoil, etc. Preliminary data shows inconclusive results regarding channelization's effect on plant communities within the sampled landforms. However, soil properties are currently being measured on site. Combining soil and vegetation data will provide a clearer picture of how channelization has affected these landforms.

P272 - Effects of Habitat Fragmentation on Biodiversity of Mammals and Arthropods on Metro-Atlanta College Campus

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Urban and suburban sprawl is increasingly responsible for the division of habits into smaller, disjointed patches. Such habitat fragmentation can greatly impact the mobility, size, and evolution of populations. A grid has been established on the campus of Georgia Gwinnett College, a relatively new school in the fast-growing metro-Atlanta area to examine species biodiversity in the region and to understand how habitat fragmentation affects the interactions of small mammals and terrestrial arthropods within the area. This grid incorporates later-succession wooded areas bracketing a strip of land periodically clear-cut/sprayed as an easement for power lines. Small mammal populations have been seasonally monitored using Sherman small mammal traps. Mammals are marked with ear tags for individual identification. Additionally, pitfall traps have been used to assess arthropod biodiversity. Preliminary results show low biodiversity of mammals overall with the power line cut playing a major role in species presence and movement.

P273 - Effects of Solidago altissima cytotype and soil nutrients on terpene production, leaf nutrients and Uroleucon nigrotuberculatum abundance

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The specific factors that drive plant genotype choice by insects remain uncertain. Though trait variation among genotypes in phytochemistry can be important, the function of plant polyploidy (i.e.

cytotype) on secondary chemistry and insect associations has not be thoroughly studied. We investigated the connection between tall goldenrod, *Solidago altissima*, cytotypes (diploid and hexaploid), phytochemistry (C, CN and terpenes) and soil nutrient level on the abundance of a specialist aphid *Uroleucon nigrotuberculatum*. Terpenes are one of the largest classes of secondary metabolites and can vary among plant genotypes. We hypothesized that chromosome number and available nutrients would affect leaf terpene concentration in *S.altissima* and affect the abundance of *U.nigrotuberculatum*. A randomized common-garden design used sixty-four plants (32 diploid and 32 hexaploid representing four genotypes (cytotype), with eight plants per genotype. We added soil nutrients to four plants per treatment, while four plants had no nutrient addition. After allowing aphids to naturally colonize our plants we quantified aphid abundance throughout a growing season. During peak aphid abundance we took estimates of plant biomass and leaf samples for phytochemical analyses. We found that both genetic variation and soil nutrients have significant contributions in determining the abundance of associated insects. Nutrients had a significant effect on aphid abundance (P=0.0178) and no effects of cytotypes or cytotypes x nutrient interaction. The biomass of 2n plants were significantly larger than 6n plants (Cytotypes effect=0.045) and high nutrient plants were significantly larger than ambient nutrient plants (nutrient effect, p>0.001).Terpenes are being analyze to see if there is different between cytotypes and nutrient treatment. This investigation shows that cytotypes and soil nutrient level in *S. altissima* can influence aphid populations.

P274 - Pollinator Nest Webs: Elucidating the succession of species associated with below ground bumblebee nests

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Alpine *Bombus* species are unable to dig their own nests, making nest site availability a limiting factor for the population size and densities of those species. Yet, even with pollinator populations in decline, there are still large gaps in our understanding of bumblebee nesting ecology. To gain a more complete understanding of *Bombus* nest ecology, I will investigate alpine pollinator nesting behavior using a nest webs approach. Nest webs are analogous to food webs and analyze the interspecific and intraspecific relationships centered around the nest sites. They have previously mainly been used primarily to look at cavity-nesting bird communities and fish communities. Now we will be applying them to alpine Bombus nests]. Alpine bumble bees are primarily below-ground nesters and are dependent on abandoned mammal burrows. However, it is unclear when and how a mammal burrow switches to utilization by bees and what the succession of species is that follows. The number of *Bombus* species competing for existing nest sites has increased from two to seven in the past thirty years, increasing concern regarding nest site availability. Multiple lines of investigation related to pollinator nest webs will be included in this project. The specific aims are as follows: 1) documentation of activity at alpine mammal burrows and 2) documentation of activity in below-ground bumblebee nests. In addition to annual species occupancy, bee nest investigations will include collection of naturally deceased individuals to perform relatedness analyses between same-species occupants that occur in subsequent years. The results of this study will provide the scientific community with crucial data on the nesting biology of high elevation bumblebee species, with important implications for the management and conservation of these keystone pollinators.

P275 - Variation in bat species diversity and activity at the Beech Ridge unit of the Obion River Wildlife Management Area

Aubree Weitzel[1], Jeremy Dennison[2], Nancy Buschhaus[1]

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During the summer months, most species of bats in Tennessee use the forested landscape to both raise their offspring and to forage. We examined the variation in bat use of an ephemeral wetland site located in the Beech Ridge Unit of the Obion River WMA June-October 2018 using both mist net and acoustic surveys. We hypothesized that hypothesized that there would be variation in species richness from summer through early fall, and that both the mist net and acoustic surveys would reflect those differences. We netted bats, identified them to species, and collected morphometric data every 3 weeks beginning mid-June during the study period. Simultaneously, we used a Wildlife Acoustics SM4BAT full-spectrum bat detector near the net survey site to record bat activity and species richness for at least two weeks after almost all net nights. SonoBat 4.2.2 North America software with western Kentucky-Tennessee regional classifier was used to assess bat activity (after files were

scrubbed for non-bat noise) and to initially identify bat passes to species, where possible. The bat passes identified to species by SonoBat were then manually vetted. During the study, species richness varied by net night and month, and similar variation was reflected in both the net and the acoustic surveys. Eight species were captured either by mist net, by acoustic survey, or by both. All of the species captured via mist net were also captured acoustically, but one species was captured via acoustic survey but not mist net. The variation in bat species assemblages within this seasonal examination of the bat community at this site may have implications for future habitat management strategies.

P276 - Effect of artificial light on nocturnal activity of medium-sized mammals on a suburban college campus

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In heavily populated areas, artificial light pollution is a growing intrusion impacting the physiology and behaviors of nocturnal animals. Many animals are attracted to lights, others avoid it. Artificial lights can disrupt circadian rhythms, predator-prey interactions, and foraging patterns. The aim of this project is to analyze the effect of artificial light on animals in a semi-natural setting (a suburban college campus). In this study, wildlife cameras will be used to observe if artificial lights affect diversity, visitation frequency, or timing of medium-sized mammals and other animals at a feeding station. We hypothesis that the presence of artificial light will lower the level of nocturnal animal activity and overall diversity of visitors compared to areas with no artificial light.

P277 - Influence of Environmental Plastics on Freshwater Macroinvertebrate Distribution in Colombia County, Arkansas

Emily Phillips, Allysia Hurt, Katrina Hall, Kate Sheehan

Southern Arkansas University, Magnolia, AR

Plastic pollution is an increasingly publicized problem that is impacting marine systems worldwide. Plastic is likely also a problem in freshwater systems; however, we know little about the quantities and distributions of plastics in freshwater habitats. Even less is known about whether these plastics are entering food webs, and the extent of damage that they might be having on local organisms. We expect that freshwater systems with higher plastic abundance will have decreased organism abundance and diversity. To test this, we assessed benthic cores collected from four water bodies in Columbia County, AR: Lake Columbia, Southern Arkansas University (SAU) Duck Pond, SAU Armory Pond, and a local cow pond. We used dissecting microscopes to process these samples by separating, enumerating, and removing all macroinvertebrates and microplastics. To date, we have found plastics in all the water bodies sampled. The median densities of plastics are just over 8,000 particles per m^2, and 555 organisms per m^2. Our preliminary observations indicate that, with increasing plastic pollution, macroinvertebrate abundance and diversity decreases. Previous studies performed in marine systems demonstrated a negative impact of plastics on organisms through physical damage and digestive disruption. Further, plastics consumed by organisms of lower trophic levels can be passed up the food chain. Because plastic is so common in the freshwater systems assessed here, we predict these contaminants are likely interacting in local food webs. To protect our natural systems, it is critical that we take steps to reduce the incidence and abundance of plastic debris entering the environment. Armed with data from studies like this one, we can demonstrate the risks that ineffective waste disposal can have in all natural systems – not just marine habitats. Once we acknowledge these problems, solutions for pollution remediation and prevention can be developed and enacted.

P278 - Splitting up a complex mess: Sharpening the tools when the old ones don't cut it

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Recent studies have highlighted a need for more refined tools in species delimitation. This is especially true when considering diversity within species complexes, where members are morphologically similar and where traditional tools have thus far failed to provide clearly defined

boundaries between species. This project seeks to refine our traditional tools of species delimitation and apply new tools to the challenges created by species complexes. The focus organisms of this study are the frogs of the *Limnonectes kuhlii*complex. This species complex comprises more than 25 species of brown, stream dwelling frogs from Southeast Asia. Traditionally, morphometrics (particularly linear measures) has been the most common way to demonstrate differences between two or more species. Unfortunately, traditional approaches to morphological analyses placed members of this group into a single, widely distributed species for nearly 200 years. Recent studies combining genetic, morphological, and bioacoustic tools have been effective in delimiting some, but not all potential species. The currently undescribed members of the L. kuhlii complex (candidate species) provide an opportunity to investigate new approaches to morphological character analyses (e.g., geometric morphometrics), and to refine traditional approaches (alternative statistical analyses) used in species delimitation. Ultimately, this project aims to recognize, delimit, and describe real biological diversity in order to facilitate conservation efforts aimed at protecting these frogs and the habitats that they live in.

P279 - Aquatic Macroinvertebrates as Bioindicators of River Health

Elizabeth Fain

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Human alterations to aquatic ecosystems can negatively impact biodiversity. The hydrologic landscape of Mississippi and Alabama has been transformed by the use of locks and dams along the Tennessee-Tombigbee Waterway. Because of these locks and dams, the river is no longer free-flowing and has controlled sections. This impact on flow may interfere with aquatic community dynamics, possibly reducing biodiversity where flow is restricted. In order to conserve freshwater communities, it is important to understand how alterations to natural river flow impact their diversity. This research compares the aquatic macroinvertebrate community composition above and below the John C. Stennis Lock and Dam in Columbus, Mississippi, to determine if dam-induced flow alterations result in a decline in aquatic biodiversity. Aquatic macroinvertebrate communities were sampled along transects above and below the John C. Stennis Lock and Dam to determine if higher abundance and species richness exist above the dam. Dissolved oxygen, flow rate, and turbidity were measured and recorded at each site. Aquatic macroinvertebrate samples taken above the dam typically had about three species and six individuals per sample, while samples taken below the dam had about one species and one individual per sample. Most aquatic macroinvertebrates found above the dam, such as scuds and dragonfly larvae, were not found below the dam. Dissolved oxygen, flow rate, and turbidity were all higher below the dam than above the dam. Results from this project are in line with similar studies, reinforcing that dams reduce biodiversity in freshwater systems.

P280 - Assessing hunting pressures and the population status of Preuss's red colobus, Piliocolobus preussi, in Cross River National Park, Nigeria

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Red colobus monkeys are the most endangered group of primates in Africa with all 19 forms threatened with extinction. The Critically Endangered Preuss's red colobus (*Piliocolobus preussi*) is endemic to the forests of southeastern Nigeria and western Cameroon. Across its limited range, hunting and habitat loss are the greatest threats to the long-term outlook of Preuss's red colobus. While most of the research on this species has been conducted in Cameroon, the conservation status of the Nigerian population remains poorly understood. Furthermore, political unrest and violence has created a major obstacle to conservation efforts in Cameroon, making the Nigerian population extremely important. The goals of this research are to (1) determine the population status of Preuss's red colobus in Cross River National Park (CRNP), Nigeria and (2) identify the spatiotemporal patterns of gun hunting. To accomplish these goals, forest reconnaissance surveys will be conducted in CRNP from May - December 2019 to collect data on the geographic distribution, abundance, and population structure of Preuss's red colobus. Acoustic monitoring sensors will also be deployed to record the sounds of gunshots to identify geographic and temporal frequency patterns of gun hunting in Preuss's red colobus habitat areas. The project will be the first to focus on the conservation status of Preuss's red colobus in CRNP and will introduce to park managers a novel, cost efficient tool – passive acoustic monitoring - to improve law enforcement monitoring and evaluation. Ultimately, we expect

this research to garner a more comprehensive population assessment of Preuss's red colobus and help with the overall improvement of the conservation status of this Critically Endangered species.

P281 - The Distribution of Microplastic Pollution in Aquatic Systems of Columbia County, Arkansas

Allysia Hurt, Emily Phillips, Katrina Hall, Kate Sheehan

Southern Arkansas University, Magnolia, AR

As consumers, we use plastic daily. Globally, over 300 million tons of plastic is produced annually. Some of this plastic is recycled, but most of it ends up in landfills, on the sides of highways, and in waterways. Widespread dispersal of plastics can result from flooding events, strong winds, and its consumption and burial by organisms in the environment. Large plastic pieces, known as macroplastics, can be broken down into microplastics through mechanical damage and weathering. To determine how prevalent microplastic pollution is in local aquatic systems, we collected benthic sediment samples in Columbia County, Arkansas. We sought to better understand how recreational use and pedestrian traffic influences plastic pollution in freshwater habitats. As such, we compared plastic prevalence from four freshwater systems. Lake Columbia is a reservoir lake that is used for fishing and other recreational activities. The Southern Arkansas University (SAU) duck pond has high foot traffic because of its proximity to housing units on the SAU campus. The SAU armory pond has relatively low foot traffic because of its remote location on the SAU campus; however, it is used daily by anglers. We also sampled from a cow pond that is rarely visited by people. We processed benthic sediment samples under dissecting microscopes, pulling all macroplastics and microplastics encountered. We found between 84 and 17,404 microplastics per cubic meter of aquatic sediment (5cm depth), with 100% of samples containing at least some plastic pollution. Our preliminary results, while alarming, can help us to better understand how much plastic is already in our aquatic systems. Further, this information can be used to communicate the magnitude of the problem that plastic pollution creates to local administration so that plans for remediation can be developed.

P282 - Macro-invertebrates as Bio-indicators of the Eno River.

Jazlyn Pointer

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Bodies of water that are close to major and developing cities are susceptible to pollution due to their close proximity to city run off and sewage waste. While these bodies of water are often treated by chemical treatment facilities for human consumption, certain macroinvertebrate populations may indicate poor stream quality. The Eno River is a brown water river that is a part of the Neuse river basin. The river runs across Durham County and Orange County, close to major cities and through smaller developing towns making it susceptible to pollution. Macroinvertebrates are used as bio-indicators due to their different levels of pollution tolerance. Data was gathered by collecting macroinvertebrates from the east and west ends of Gold Park in Hillsborough, NC. Both locations were chosen due to proximity to parts of town. The macroinvertebrates in both sites were collected using the D-frame dip net and rock wash techniques. The specimens were preserved using 70% ethanol, identified with the use of several dichotomous keys and then entered into a biotic index calculator to determine the health of the water. The first sample taken from the west end of Gold Park consisted of 49 specimens with a tolerance value of 273.6 and a biotic index of 5.58. These numbers indicate that the water quality is fair with a likely possibility of substantial pollution. Due to remaining specimens in need of identification and calculation, no definitive conclusions can be drawn, however preliminary data show the Eno River has a water quality rating of "Fair" and is substantially polluted, meaning the river is not in optimal condition despite ongoing water treatment.

P283 - Estimating Mammalian Activity Patterns in Old Growth with Camera Traps

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Camera trapping is an increasingly popular method to study wildlife populations in the field due to its non-invasive nature and ability to detect many species over large study areas. Many studies using this method have focused on ecological edges and corridors where various species converge. For example, rodents have been reported to prefer edge habitats, and thus increased species richness of

predators in these areas is hypothesized to be due to rodents' ecological role as prey populations. Building on this, our study was conducted at Lilley Cornett Woods (LCW), a field station located in southeastern Kentucky which includes ca. 100 ha of old growth forest. The objective of this study was to estimate the detection rates and diversity of mammals in relation to the edges of an old growth forest, and to an elevational gradient, using camera traps. Browning Strike Force cameras were deployed at regular intervals along the two trail systems covering LCW and moved weekly. Camera deployments had one of three bait types: sardines and fatty acid scent tablets (to attract mesopredators and other mammals), apple halves (to attract rodents), and no bait (passive rate of mammal activity). All images and metadata were processed through Wild.ID v9.28. Mammalian response variables were correlated against spatial predictors using RStudio. Distance to the old growth edge and elevation were both inversely correlated with mesopredator detection rates ($p=0.01$, $p=0.03$, respectively). However, no other correlations were significant, suggesting that the higher mesopredator detection rates closer to the edges was not driven by the rodent prey populations. Our findings suggest that other ecological factors are driving the differences in mesopredator populations along edge habitats at lower elevations.

P284 - Pine rockland grass seed germination response to smoke water seed pretreatments

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Pine rocklands are an endangered ecosystem in Florida that are rapidly declining due to fire suppression, development, and invasive species. Conservation efforts include restoring degraded rocklands and one method for reestablishing native species is sowing native seeds. Since some species respond to both physical and chemical germination cues, pretreating seeds before sowing may lead to faster and more reliable germination. There is a lack of information concerning effective pretreatment methods for pine rockland seeds, but smoke chemicals can promote germination for some species adapted to fire-maintained communities. The purpose of this project was to determine the effectiveness of smoke water as a seed pretreatment. A germination trial was conducted on seeds of the pine rockland grass *Eragrostis elliottii* that had been soaked for 24 hours in smoke water diluted to six treatment concentrations (0% (control), 10%, 25%, 50%, 75% and 100%). Within each treatment, 10 plates with 10 seeds each (100 seeds total) were observed every two days for 66 days, and total germination, germination speed, and mean germination/plate were monitored. Total germination percentages for the control, 10%, 25%, 50%, 75% and 100% smoke water treatments were 32%, 64%, 65%, 63%, 57%, and 66% respectively. Germination speed (time to reach 50% of the final germination) ranged from 10-14 days and was similar among treatments. However, mean seed germination per plate in the control treatment (3.2±0.3) was significantly lower than the 10% solution (6.4±0.6), 25% solution (6.5±0.4), 50% solution (6.3±0.4) and 100% solution (6.6±0.5). No other significant differences in mean germination between treatments were observed. Our results suggest that the presence of smoke water enhances germination of *E. elliottii* seeds, but altering smoke water concentration level does not appear to significantly affect germination amounts.

P285 - Siren intermedia Colonization of a Recently Constructed Wetland

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The world has lost 87% of wetlands since 1700, which has undoubtedly affected many wetland-dependent species. While these effects are better understood in other taxa, many amphibian species are highly dependent on wetlands for breeding, foraging, and cover. In response to wetland loss, restoration and construction of wetlands has been increasing, though little is known about how recently constructed wetlands are colonized and used. *Siren intermedia* (Lesser Siren) is a top vertebrate predator in many wetland ecosystems, and can colonize newly constructed wetlands via drainages and channels. To better understand population parameters in a recently constructed (<5 years old) wetland in southeastern Missouri, we monitored a local population for 20 months. Each month, we set 19 minnow traps and checked them daily for 4 trap nights; all captured salamanders were marked and measured in the lab, then released. In total, we captured 123 unique salamanders.Total biomass was greatest during March 2017 with a maximum of 1755.1g in a single trapping cycle. Peak biomass coincided with peak abundance during late winter. Recaptures were

more common in the summer season relative to the other seasons. Preliminary estimates of the population are >500 unique individuals. Our results for peak wetland use by *Siren* are similar to other published studies. Overall, our study demonstrates that *Siren* will utilize newly constructed wetlands and populations have the potential to function similarly to natural wetland habitats. Further studies should investigate the usage of wetland-dependent species of constructed wetlands and best management practices.

P286 - Modeling the Effects of Foliage Management on Floral Abundance and Bombus impatiens Population Dynamics

William Vannoy

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Bumble bee populations worldwide are declining. There is widespread recognition that recovery and maintenance will require conservation of resources required by pollinators particularly floral (food) resources. Land management, particularly mowing of lawns, roadways, and wild meadows impacts flower yield and thus the total resources available to for foraging bees. This study will examine the consequences of management ('mowing') of roadside and old meadow habitats of the Southern Appalachians for a locally abundance native bumble bee, *Bombus impatiens,* using a combination of experimental and modeling methods. Eighteen transects, each 20 M2, were established during Spring 2018 on land managed by the Blue Ridge Parkway, North Carolina. Transects were sampled weekly for floral abundance of five flower species which are known mutualists of *B. impatiens*.. The transects were mowed every second week, every fourth week, or never. Nectar production rates of flower species were analyzed using a nectar wash method and spectrophotometry. Abundance and nectar data will be used to generate potential floral landscapes under different mowing regimes and to model the impacts of this on *B. impatiens*. Preliminary floral abundance analysis shows that the effects of mowing are variable across flower species, but overall detrimental to floral abundance. When all flower species were analyzed as one population there was a significant decline due to mowing. When analyzed independently from each other only the wildflower *Solidago rugosa* was shown to have a significant decline in abundance when mowing treatments were implemented. To determine whether foliage management (mowing) could deplete floral abundance to an extent detrimental to pollinator populations, theoretical landscapes were made with mowing data and life history information about *Bombus impatiens* to determine effects on the population dynamics of the bee. Ultimately this study could provide valuable insight into potential impacts on pollinators that occur due to foliage management policies.

P287 - Prevalence of Plastic Debris in the Digestive Tract of Cattle

Paige Lawson, Kate Sheehan

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Plastic products are a ubiquitous part of contemporary consumer products. Today, most plastics are composed of a multitude of toxic chemicals like plasticizers, colorings, flame retardants, and antimicrobials. These substances are speculated to be toxic to organisms that consume them, and consequently, could be leached from the plastic during digestion. Here, we document the prevalence, abundance and degradation of plastic debris in cattle on the campus of Southern Arkansas University (SAU) in Magnolia, Arkansas. After finding an alarmingly high occurrence of microplastics (45%) in fecal samples of SAU cattle, we recognize the threat of plastic pollution, not only to the cattle, but also to humans consuming beef from these herds. Certain factors, such as age of the cow, pasture use, mineral supplementation, and feeding of bailed hay could influence the incidence of plastic contamination. We assessed those data with logistic regression and Chi-square analysis to determine the likelihood of consumption between the different groups of SAU cattle, and used discriminant analysis to predict plastic consumption given multiple covariates. We also monitored plastic digestion rates through four consecutive trials (1 week, 2 weeks, 4 weeks, 8 weeks) where segments of bailing twine were placed in Dacron© bags and inserting into the rumen of a cannulated bull. Our preliminary results suggest plastic degradation occurs at a seemingly high rate, as indicated through changes in dry weight and progression of particle fraying (processed images with ImageJ). Future needed assessments include the verification of absorption of toxic plastic chemicals to evaluate whether the beef from these herds is safe for human consumption. With this information, we can recommend improved farming practices and pollutant reduction plans to preserve the quality and integrity of these cattle.

P288 - Scent Lures; Do They Work for Small Mammal Sampling?

Maggie Woodall, Jancy Burge, Michael Bender

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Small mammals play vital ecological roles and are often the most abundant component of the mammal community in a given ecosystem. In most instances, small mammals have highly developed olfactory senses that are the primary sensory system used for navigation, interspecific communication, and most importantly location and evaluation of food resources. The importance of olfaction presents a potential opportunity for small mammal researchers to minimizing the challenge of keeping traps clean and potentially the negative effects of ants on trapping that are typically associated with small mammal sampling using traditional baits in the southeastern U.S. Our objective for this project was to evaluate the efficacy of scented cotton balls as an alternative to traditional small mammal bait. To achieve this objective we sampled small mammals using both traditional and scent baits with Sherman and snap traps during September-November 2018. Based on 330 trap nights, capture rates were low but similar between scent bait and traditional bait (traditional – 0.066/trap night, scent – 0.048/trap night). Anecdotal evidence suggests that ants were less often associated with the scent bait than the traditional bait. Although more data collection in the field and lab-based behavior trials with ants is needed, our preliminary data suggest that the use of scent baits has potential benefits and should be considered more carefully as an alternative to more traditional small mammal baits.

P289 - Investigating seasonal and annual patterns in water quality in a freshwater aquaponics system

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Aquaponics is a sustainable food production system that combines hydroponic plant growth and fish production via aquaculture. Within an aquaponics system, wastewater high in ammonium in fish tanks is converted into a fertilizer source (i.e., nitrate) for plant growth through the action of nitrifying bacteria. Excess nutrients are removed from the water through plant uptake, after which the clean water is cycled back into the fish tank, thereby eliminating the necessity of water changes for fish production and fertilizer additions for plant growth. To maintain optimum growing conditions for fish, bacteria, and plants, it is important to regularly monitor water quality in the system. The purpose of this study was to determine if there were annual and/or seasonal patterns over the course of one calendar year in the water quality of an aquaponics system. Specifically, water samples were collected weekly from the multiple locations within four replicate aquaponics systems: fish tank, settlement tank (for solids removal), four sections of plant grow beds (upper or nearest to the inflow of effluent, two middle, and lower or near the outflow of effluent), and the collection tanks (for collecting cleaned water for recycling into the tanks). Each water sample was then analyzed for pH, dissolved oxygen, conductivity, ammonium, nitrate, and potassium using Vernier probes. The data are currently being analyzed for annual and seasonal patterns in water quality and correlated to ambient temperature and humidity. The results of this study will provide valuable information on the influence of climatic variables (e.g., temperature and humidity) on water quality within a freshwater aquaponics system.

P290 - Testing Island Biogeography Theory using small mammals on islands in Lake Lanier

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Much has been written on the theory of island biogeography and the importance of island size and connectivity to the resident community. This theoretical work typically has been tested on large marine islands, but few studies have looked at how applicable the theory is to freshwater islands. The construction of Lake Lanier in 1956 resulted in the creation of numerous islands that, in large part, have been isolated from the mainland since the initial flooding. These islands provide an opportunity to test the applicability of island biogeography theory to the small mammal community on islands in a freshwater habitat, but we were unable to find any previous small mammal research associated with islands in Lake Lanier. Therefore, we initiated a project in which our objectives were to determine 1) if

small mammals currently reside on these islands, and 2) the influence of island size and isolation on the diversity and abundance of small mammal captures. During the initial stage of this project, we surveyed small mammals on six islands in Lake Lanier using Sherman traps and snap traps from 17 September to 17 November 2018. Sampled islands ranged from 2.4ha to 60ha, and distance to shore varied (187m - 884m). We captured four mammals in 1227 trap nights including 1 black rat (*Rattus rattus*), 1 cotton rat (*Sigmodon hispidus*), and 2 chipmunks (*Tamias striatus*). Three of the captures were the product of 174 trap nights on the smallest island sampled, and one capture was the result of 448 trap nights on the largest island sampled. Future efforts will focus on increasing our sample size, the use of track plates to locate productive areas, evaluating the influence of island size and connectivity on our captures, and sampling mainland areas to determine how the island communities differ from the mainland community.

P291 - Microfiber Prevalence and Abundance in Freshwater Fishes from Lake Columbia, AR

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Reports of microplastic consumption by fish have increased over the last several years, with the majority of reported cases stemming from marine ecosystems. Thus, there is a gap in our understanding of the distribution of microplastic pollution, where terrestrial and freshwater data are slow to accumulate. Here we document the prevalence and abundance of plastic consumption by fishes in Lake Columbia, Arkansas. Lake Columbia is a reservoir in rural southwest Arkansas and does not receive much human traffic compared to more popular recreational lakes in the area. Thus, we predicted that microplastics would not be very prevalent in this system. We looked for microplastics in fishes from a variety of trophic levels, feeding strategies, body sizes, and habitat use. We collected seven fish species by seine net, minnow trap, and rod and reel. Plastics and food items collected from the digestive tracts were photo documented and preserved. Preliminary findings indicate that 40% of all fishes collected in Lake Columbia contained microplastics with an average of three microfibers per fish. This number is surprising given the rural location of the lake and minimal impact from cities or industry. The frequency of plastic pollution entering the food web is also of concern because of the detrimental effect that toxic chemicals leaching from microplastics might have on the fish and their predators – humans. Additionally, plastics can be problematic when consumed if they injure or block the digestive tract. Thus, documenting the incidence and severity of plastic inclusion into the diets of freshwater fishes is important for understanding how pollution affects ecosystem services of important recreational areas. It is critical for plastics research to expand into freshwater systems as this is certainly not only a problem in marine ecosystems.

P292 - Analysis of Morphological and Genotypic Variation Among Populations of Lactuca hirsuta var. sanguinea

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Lactuca hirsuta var. Sanguinea, commonly known as wild, hairy lettuce, is a variety of a species within the *Lactuca* genus. While *Lactuca hirsuta* is found in several locations in the northeastern United States, this particular variant is considered endangered and has only been documented around Massachusetts, with the largest known populations growing on Nantucket Island. On this island, five populations were located and a number of morphological measures were collected along with seeds and leaf tissue. This data was then used to construct a principle components analysis (PCA) of the morphological variation among individuals, and four chloroplast primers as well as nuclear primers were used to locate genetic variation among individuals. This data allows for populations with unique alleles in their gene pool to be isolated and placed as a high priority for conservation efforts of local groups.

P293 - A Comparative Survey of the Morphology of Faxonius sp. Crayfish at Streams in Giles County, Tennessee

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Crayfish are highly imperiled in North America. Threats like habitat fragmentation, degrading water quality, and invasive species have caused certain crayfish species to become threatened, therefore further research is necessary in order to track crayfish populations. The purpose of this study was to survey *Faxonius* sp. crayfish size and morphology at three creeks in southern Tennessee. Hand-held seines were used to collect crayfish during November 2018 to February 2019. Following collections, we identified gender, measured carapace length (CL-mm), total length (TL-mm), and weight (g) for each crayfish. Results showed that crayfish FL differed significantly among sites (ANOVA, $F(2, 81) = 5.671$; $p < 0.05$). Weight and CL did not differ significantly among sites (ANOVA, $F(2, 81) = 1.997$, $p > 0.05$; $F = 2.901$, $p > 0.05$) respectively. Previous research has not been conducted in this region of Giles County, Tennessee, so annual surveys will be done to determine the status of the crayfish morphology and population estimates in the future. This data assist in determining possible factors, such as water quality, habitat degradation, or invasive species, which might attribute to a change in the morphology or decrease in population densities.

P294 - Monitoring bat activity as white-nose syndrome becomes established in the North Carolina Piedmont region

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White-nose syndrome is a fungal disease that has caused millions of deaths of cave-hibernating bats in North America since its appearance in the state of New York in 2006. Whereas some bat species (*e.g.,* tricolored bats, *Perimyotis subflavus*) appear to be especially susceptible to fatal cases of white-nose syndrome, some other bat species (*e.g.*, eastern red bats, *Lasiurus borealis*) do not show disease symptoms even when they come into contact with *Pseudogymnoascus destructans*, the causative agent of white-nose syndrome. Still other bat species, such as big brown bats (*Eptesicus fuscus*), seem to be susceptible to the disease but have more resistance than tricolored bats. Given that all of these bat species feed on flying insects at night, a precipitous decline in some species might allow for competitive release in other species. To address the question of whether changes occur in the prevalence of different bat species as white-nose syndrome becomes established in the region, we are using acoustic monitoring and mist-net capture to census summer bat activity at four sites in Stokes County, NC, where WNS was first detected in winter 2016-2017, and five sites in neighboring counties in which white-nose syndrome has not yet been detected. So far acoustic activity data do not show a pattern of decline over 2015-2018 in tricolored bats, nor in any of the other five bat species that have been acoustically detected at the sites being monitored. These results suggest that white-nose syndrome might not have yet dramatically impacted bat populations in the northwestern Piedmont region of NC, and the data may serve as a baseline for comparison as prevalence of the disease increases.

P295 - Off-road vehicle use as a growing source of wetland disturbance in central Appalachia, USA

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Organized trail systems for all-terrain vehicles (ATVs) are a burgeoning source of landscape change in central Appalachia, USA, with more than 2,500 miles of roads and trails constructed for ATVs across this region. ATV trail development is often targeted towards embedded habitat features such as isolated wetlands, which may experience damage to vegetation, soil, and water quality from vehicle use. However, little work has attempted to estimate the extent of wetland impacts from ATVs across the Appalachian region. I used 15 years of archived, high-resolution aerial imagery and National Wetlands Inventory data to quantify ATV damage across 71 wetlands from four sites in southwest Virginia, USA, including two organized, state-managed ATV trail systems and two adjacent, undeveloped habitat blocks of similar size. ATV damage was associated with closer wetland proximity to established trails and roadbeds at all sites, with more than double the amount of wetlands exhibiting signs of ATV damage on formal trail systems as opposed to undeveloped control sites (approximately 22 hectares total across all sites). Annual rates of wetland damage at undeveloped control sites also increased following the establishment of nearby organized trail systems, a finding that questions assumptions about organized trail systems curbing illegal off-road use. These results indicate that wetland damage from recreational ATV use is a widespread and

growing source of habitat disturbance in the Appalachian region, with potentially broad implications for water quality and wetland biota.

P296 - The Effects of Wetlands and Forest Opening Size on the Richness and Abundance of Early-Successional Birds

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Early-successional forests are disturbance dependent environments that are the main habitat for many species of early-successional birds that require the shrubby vegetation for a successful breeding season. The abundance and richness of these birds has been shown to be influenced by openings size but the presence of wetlands within openings has not be observed. This study looked at the influence of forest opening size and the presence or absence of wetlands within forest openings on the species richness and abundance of eleven indicator species. Data was collected using point counts and habitat surveys as described by the USFS in 1996. A total of 136 indicator species individuals were detected during 27 point counts. The size of the opening significantly influenced the indicator species richness with a greater species richness within the large openings. The presence of wetlands did not significantly influence indicator species richness. There was also no interaction between wetland presence and opening size. Indigo bunting, yellow-breasted chat, and common yellow throat had a greater abundance within the large openings. White eyed vireos and blue-winged warblers were not influenced by forest opening size. Only the blue-winged warbler showed a greater average abundance in openings without wetlands. This study found that species richness and abundance of early-successional birds were not influenced by the presence of wetlands, but that they were influenced by the size of the forest openings. Management plans such as maintaining more large forest openings and mowing the openings after the breeding seasons are crucial to the conservation of early-successional birds and should be implemented.

P297 - Estimating Black Bear Occupancy at Jellico Mountain Using Baited Camera Traps

Gage Shepard

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Black bears (*Ursus americanus*) were essentially extirpated from Kentucky by the early 1900s due to habitat loss and unregulated hunting. In the last 20 years, bears have been recolonizing Kentucky as a result of habitat becoming more available, laws being made, and reintroduction programs being put into place. With the range of black bears extending back into Kentucky, the need for conservation and management increases. Accordingly, I conducted a non-invasive survey of black bears using baited camera traps in order to estimate occupancy and detection probability at Jellico Mountain, Kentucky. The mountain, which was surveyed for 8 weeks in 2010 and detected 0 bears, was divided into 18 grids (5x5 km), with one camera placed in each grid. All sites were baited with corn and peanut butter, and each site was checked weekly with bait being added as needed. To assess occupancy, presence/absence data were collected from the pictures, and the data were analyzed using R package “unmarked”. Covariates of elevation and burn history were incorporated into the occupancy model to obtain site specific probabilities. Eight of the 18 cameras detected black bears over the course of 5 weeks. Covariates of elevation and burn history were not good predictors of occupancy. For this reason, the covariates were not included, leaving constant detection and occupancy probabilities across all sites. The predicted occupancy probability was 0.449, and the predicted detection probability across the landscape was 0.326. Modelling results indicate it would take approximately 5 weeks of camera surveying on Jellico Mountain to reach a 90% chance of detecting a black bear. Collectively, these results indicate that black bears have moved into the study area in the past 8 years, occupying about 50%, and they give a better understanding of surveying methods/strategies for future conservation efforts.

P298 - The Utilization of Citizen Science as a Means to Monitor Invasive Species Populations in Ohio

Rebecca Ohm, Kevin Ruegg, Gregory Smith

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Invasive species are one of the most globally pervasive threats to the conservation of biological diversity. As citizen science has expanded its utility by engaging more non-scientists, the potential exists for a popular citizen science platform (iNaturalist) to aid in invasive species management. This study quantified the reliability and accuracy of collecting data on invasive species through citizen science programs. We hypothesized that the use of citizen science data would be an effective means of monitoring invasive species populations within Ohio, and that more populated regions of the state would have an increased rate of detection of invasive species. Data were collected using iNaturalist within the state from 2012 to 2018. Records for twenty-two invasive species were examined for location of the species and number of observations per county. Of the twenty-two focal species, 2310 research grade observations were recorded. The location and quantity of observations were correlated with human population of the county in which the species were observed. Preliminary results suggest that observations are not correlated with human population. However, results may be confounded by the fact that observations, in general, were clustered around the most populated areas of the state. Citizen science may be an important tool that can be used to locate areas of concern for high levels of invasive species, and ultimately aid in the persistence of native species that have been negatively affected by invasives in those areas.

P300 - An Evaluation of Reforestation Pathways on Insect Richness in the Tropical Dry Forests of Panama

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Tropical dry forests are one of the most threatened ecosystems on the planet, and conservation is dependent on reforestation. Insects play important ecological roles in tropical dry forests and can act as valuable bioindicators of reforestation success. On the Azuero Peninsula in Panama, reforestation practices have been increasing over the last 30 years. To evaluate the effect of different reforestation strategies, we compared insect richness between three 15-year-old forests (an exotic-teak plantation, a native-species plantation, and a 15-year-old secondary forest) as well as within a mature-secondary forest. During a week period in the middle of the dry season, we sampled using nets and pitfall traps at four transects in each forest type. Here we discuss the insect richness in relation to forest type, canopy tree diversity measures, and the abundance of pollinator species relative to flower abundance. Data from this study will be added to the PREDICTS database to assist collaborative effort to understand how terrestrial species respond to human pressures.

P301 - Can you trust the results of your automated bat call classifier?

Sara Robertson

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Interest in bats and the vital ecosystem services they provide has increased substantially in recent years as the myriad threats bats face have drastically reduced many populations. This interest has resulted in increased survey efforts, many of which are acoustic in nature to minimize the detrimental effects surveys can have on stressed populations. While the ability to assign species identity to bat calls has improved in recent decades, the process remains challenging and often lacks objectivity and repeatability among researchers. To address these issues and improve the speed of the identification process, several automated bat-call classifying software programs were developed in recent years and are becoming widely used. Unfortunately, these programs may not perform well in all areas depending on the quality of the recorded calls, the composition of the resident bat community, and a multitude of other factors. Our objective for this project was to determine if two classification programs, which are currently approved by the Fish and Wildlife Service as automated bat-call classifiers, produced similar results with the same dataset. To accomplish this objective, we collected bat calls with two Anabat Swift detectors in a forest landscape between July – August 2018 in Lumpkin co., GA, and classified the dataset using both classification programs. The dataset contained 148,563 total files and approximately 800 identifiable bat-call files. In general, we found little agreement between the two classification programs, consequently, we recommend caution when relying solely on software programs to determine presence/absence of species in a particular area. When species ID is not critical, using acoustic data and automated software to determine general indices of activity and indicate possible residents may be more appropriate than attempting to ID each call to species and conclusively determine residents because of the high degree of uncertainty that remains when attempting to ID calls.

P302 - Assessing Geographic Patterns of Genetic Variation and Gene Flow in North Carolina Populations of the Gopher Frog (Rana capito)

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The gopher frog (*Rana capito*) is considered an endangered species in North Carolina (NCWRC 2014). This species primarily occurs in long leaf pine forests, which have suffered a 97% reduction in distribution due to fire suppression and development over the last century. Now, many species associated with this habitat type are listed as threatened or endangered. Prior studies have produced broad-scale genetic information for gopher frogs from across their range in the southeastern United States, but little fine-scale genetic data are available for the seven known populations of gopher frogs in North Carolina. Thus, there is a need to obtain such information on gopher frogs in North Carolina in order to effectively manage the species in the state. Understanding the genetic architecture of gopher frogs will provide critical information necessary for conservation practices, including potential translocation of frogs between sites or augmentation of populations that have relatively low levels of genetic diversity with individuals from more genetically diverse populations of this species. Here, we present our analyses of nucleotide sequence variation in the mtDNA ND2 gene and a portion of the non-coding control region for North Carolina populations of *R. capito*. Our results indicate that mtDNA sequence variation within and among the NC populations is relatively small. Moving forward, we will also genotype individuals from these populations using microsatellite markers in order to assess finer-scale geographic patterns of genetic variation as well as relatedness of individuals sampled from a given site. Overall, the genetic information we collect can be used as a framework for guiding conservation and management decisions for gopher frogs in North Carolina.

P303 - Use of elkwallow habitats by waterfowl in southwest Virginia, USA

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The central Appalachian Mountains of southwest Virginia are a well-known hotspot of biodiversity for several taxonomic groups, including freshwater mussels and amphibians, among others. Recently, efforts have been made to reintroduce some species from this region that have experienced past declines or extirpation. The Rocky Mountain Elk, a surrogate of the now-extinct Eastern Elk, is one such species introduced to Buchanan County, Virginia on a series of former surface mines. One outcome of reintroducing elk to the landscape is the creation of new elkwallow habitats and the enlargement of existing wetlands used by the species, which may impact other resident wildlife. The objective of this study was to understand if and how waterfowl - one group of wetland-associated species commonly found on former surface mines - use elkwallow habitats within the introduced range of elk in Virginia. Data from game cameras installed at four large elkwallows at Virginia's primary reintroduction site were compared to data from several nearby wetland sites not associated with elk to examine habitat use by waterfowl. We detected substantial use of elkwallows by waterfowl, particularly Wood Ducks, and found that waterfowl are likely using elkwallow habitats as migratory stopover locations, similar to their use of more generalized wetlands on former surface mines. While more work is needed to ascertain if and how elkwallows differ from other wetlands found within the central Appalachians, it is likely that elkwallows may supplement available wetland habitat for numerous taxa across the broader region.

P304 - Investigations into the reproductive biology of the Southern Appalachian endemic Piratebush (Buckleya distichophylla): Pollination biology, fruit development, and seed germination

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Endemic to the mountains of Tennessee, North Carolina and Virginia, piratebush (*Buckleya distichophylla,* Santalaceae) is a rare, dioecious and hemi-parasitic shrub with a scattered and isolated distribution. Vegetative reproduction and few visible seedlings within the densest population of piratebush on Poor Mountain in southwest Virginia emphasize the need for research into this species' reproductive biology to inform conservation strategies. Pollination data showed no evidence

for wind pollination, instead multiple diurnal floral visitors to staminate flowers were observed. Fluorescence microscopy of stigma and styles on initiated fruits revealed almost 95% with pollen deposition. Most initiated fruits (52%) had tube growth continue to the base of the style, indicating potential fertilization. Pollination experiments showed outcrossing was necessary for fruit set, agamospermy does not occur. Non-pollinated flowers in bags had 0% fruit development, whereas fruit development in both open pollinated (86%) ($p << 0.0001$) and hand pollinated (65%) treatments ($p<<0.0001$) were significantly greater. Embryo viability analysis indicated 73% of seeds had healthy embryos. Germination trials indicated that seeds must undergo stratification for successful germination. Germination for control (70.9%) and 10 min bleach (72.6%) treatments were significantly higher than mechanically scarified fruits/seeds (27.2%), suggesting a potentially negative impact that rodent gnawing would have on seed germination. Further, evidence of heavy seed predation was observed. These results suggest that there may be sufficient pollinators, successful outcrossing and seed development, and that embryos are viable and have the potential to germinate, but imply that seed predation may be a key reproductive constraint for piratebush.

P305 - Genetic Sex Ratio Analysis of the American Pika (Ochotona princeps) in the Rocky Mountain Region

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Sex ratios (the ratios of female to male individuals in populations) provide valuable estimates of the health of populations. In species that are territorial and occur in small, isolated populations, biased sex ratios can lead to increased competition among individuals and decrease the genetic diversity of future generations. Having fewer mating opportunities results in the majority of offspring in the next generation coming from only a small number of parents, thus increasing the relatedness of individuals. The American pika (*Ochotona princeps*) is a small, alpine mammal that is predicted to experience habitat range contractions due to climate change. As this occurs, the range will also become more fragmented, decreasing the connectivity of populations. Because of this, understanding which populations are most vulnerable is of utmost importance. Sex ratios are key indicators of a population's potential persistence and, therefore, a part of this understanding. Species that lack significant sexual dimorphism, such as the American pika, can be difficult to sex in the field, requiring a need for genetic based sexing techniques. Chromosomal genetic sexing techniques have been developed using non-invasive hair sampling. In this two part study, we first expanded the use of this method to include fecal samples, performing pairwise comparisons of 13 individuals who were sexed using extractions from both hair and fecal samples to ensure accuracy. Secondly, we sexed 86 pikas from either fecal or hair samples obtained from eight populations in the Colorado and Montana Rocky Mountains. Sex ratios for each population were calculated. We observed sex ratio bias (1 female: 1.75 male) in one population. These findings, along with further analysis of the geographic factors that may contribute to sex ratio bias, will be discussed.

P306 - Data added to remote camera surveys by video footage

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Remote camera surveys are a standard technique for studying wildlife and may be used to record photos or videos or both. Data management and storage are a significant logistical burden using this methodology. We quantified the added data value of sequential photo/video sampling over photo sampling alone. From our study site in southcentral New Mexico, we examined 427 photo/video events from Cuddeback Capture cameras and quantified the benefit of video capture in terms of added information, storage requirements, and person time needed to analyze these photo/video data. Videos were 10 seconds in length, totaling 71 minutes, used 1 gigabyte of storage space versus the c. 423 megabytes for the photos, and required approximately 28.5 person hours for analysis. Of 427 photo/video events recorded, 237 videos contained no animal image. From the remaining 190 videos, 26 total individuals were added to the photo data. Data added included 9 Wild Turkey (*Meleagris gallopavo*), 5 mule deer (*Odocoileus hemionus*), 4 elk (*Cervus candadensis*), 3 bison (*Bison bison*), 2 domestic horses (*Equus caballus*), 2 coyotes (*Canis latrans*), and 1 Morning Dove (Zenaida macroura). With respect to demographic data added, 13 of these were adults of indeterminant sex (3 *M. gallopavo*, 2 *E. caballus*, 2 *C. canadensis*, 2 *C. latrans*, 2 *B. bison*, and 1 *O. hemionus*) , 10 were

adult females (6 *M. gallopavo* and 4 *O. hemionus*), and 3 were juveniles (2 *C. elaphus* and 1 *B. bison*). Our study suggests that little information is gained from the use of photo/video sampling over photo sampling alone given the additional costs in storage space and personnel time. However, the information gained with photo/video sampling varied by species and demographic. This technique may be more valuable to studies focusing on herding animals or reproduction.

P307 - Population Dynamics and Unique Foraging Ecology of Copperheads in the Red River Gorge, KY.

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Recreational areas can serve as important economic resources, as well as an effective tool for public outreach, education, and wildlife conservation. Naturally, recreational site use also facilitates interactions between humans and wildlife, which, in some cases, can result in conflict. These trade-offs can make management a difficult task, especially when organisms that are generally perceived as dangerous by the public are involved. Copperheads (*Agkistrodon contortrix*) are one such species commonly encountered by humans at recreational sites. In some cases, copperheads have been observed aggregating in campgrounds and similar areas, presumably to feed on emergent cicadas, but this behavior has never been formally studied. We investigated the relationship between this seemingly unique behavior and the demographic structure of a population of copperheads foraging at a single site. We constructed Robust Design capture-recapture models in order to obtain estimates of survival and recapture probabilities. Our results show the effects of time, sex, and mass as they relate to demographic structure and foraging behavior. Our goal is to use this knowledge of copperhead ecology to develop sustainable management practices at recreational sites that (1) reduce the level of human conflict with copperheads, and (2) facilitate public understanding of ecological concepts in order to promote conservation, as well as recreation.

P308 - A Reassessment of the Crayfishes of Pennsylvania's Lake Erie Basin with an Emphasis on Zoogeography, Taxonomy, and Conservation

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An investigation is currently underway to reassess the crayfishes of the Lake Erie basin in northwestern Pennsylvania. A total of 54 stream sites were sampled, with a majority of the streams in the basin sampled at least once. Preliminary data have revealed that the most common crayfish species are *Cambarus robustus* (Big Water Crayfish), *Faxonius propinquus* (Northern Clearwater Crayfish), and *Cambarus carinirostris* (Rock Crayfish) respectively. *Faxonius obscurus* (Allegheny Crayfish) was discovered in one tributary to Elk Creek and a tributary to Lake Erie, not supporting prior belief that *F. obscurus* was forcing *F. propinquus* into smaller tributaries. Three additional species, *Faxonius immunis* (Calico Crayfish), *Creaserinus fodiens* (Digger Crayfish), and *Cambarus spp*. were collected via trapping. *Procambarus acutus* (White River Crayfish), an invasive crayfish species, was also collected via trapping. The presence of such a diverse crayfish fauna is likely due to the postglacial movement via stream and wetland migrations. The Lake Erie basin represents a range overlap for northern and southern crayfish species, and is a unique location within Pennsylvania's watersheds.

P309 - Using Flow Cytometry to Determine the Reproductive Cycle in Mice

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Rodents are routinely used to study female reproduction due to a short reproductive cycle that repeats every 4-5 days. Mice make an excellent model to study changes in the estrous cycle due to their well-studied, predicable cycle. The most commonly used method of estrus staging in mice is by cytology of vaginal lavage. Samples are viewed under the microscope and the stage of estrus is determined by the proportions of cells present. This is a good qualitative method but can be difficult and time consuming for students to become proficient at performing. This method also poses issues in identifying transitional stages when mice are transitioning between two stages of the estrus cycle.

We propose a quantitative method of estrus staging using flow cytometry. We have utilized forward scatter and side scatter to distinguish three unique populations of cells on the flow cytometer; these correspond to three specific populations of cells (leukocytes, nucleated epithelial cells, and cornified epithelial cells). The specific percentages of cells found in each of the populations enable identification of the stage of the estrous cycle. This paper outlines a simple, quantitative method for quickly and accurately determining stages of the estrous cycle in mice that can be readily mastered by undergraduate students.

P310 - Histological techniques reveal differences in intersex occurrence and severity in Largemouth bass (Micropterus salmoides) and Spotted bass (Micropterus punctulatus)

Abigail Abernathy, Elizabeth Klar, Cherish Jordan, Meenal Joshi, Michael Newbrey

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Previous studies have not adequately quantified the severity of feminization between cross versus longitudinal sections of testes. A high occurrence of severe intersex could affect the long term reproductive success of a fish population. Intersex is characterized by the presence of one or more oocytes in the gonads of a male fish and the severity is dependent on the number and arrangement of these oocytes. Our goal was to compare the occurrence and severity of intersex between two sampling techniques, cross and longitudinal sections of testes; the most informative technique should provide the highest severity. Using boat electrofishing, we collected Largemouth bass (*Micropterus salmoides*) (n = 18) and Spotted bass (*Micropterus punctulatus*) (n = 25) from Lake Oliver, a reservoir of the Chattahoochee River, Columbus GA. Testes from each fish were removed, weighed, and preserved in 10% neutral buffered formalin. For each fish, one testis was cut into three cross sections, while the other was cut longitudinally. The tissues were processed, embedded in paraffin, and sectioned with a microtome at 5 µm, mounted to a glass slide, and stained using hematoxylin and eosin. In our initial assessment, we found that the two sectioning techniques gave different percentages of intersex and intersex severity. When the method of longitudinal sectioning was used, 78% of the Largemouth bass were found to have intersex with an average severity index of 1.67. In contrast, the method of cross sectioning identified the occurrence of intersex to be 53% with an average severity index of 0.87. The most common sampling technique to assess intersex is cross sectioning, but our data suggests that longitudinal sectioning may be a more accurate method to use.

P311 - Does Fitness Level Change the Dive Reflex Response?

Laurin Jones, Joni Criswell

Anderson University, Anderson, SC

The dive reflex is the body's physiological response to submersion in cold water while shutting down parts of the body in order to conserve energy (Wittmers, 1987). This often occurs in individuals who are deep sea divers and travel to the dark depths of the ocean where the temperature drastically decreases. During the dive, heart rate and blood pressure decrease. Compared to individuals who do not exercise regularly, individuals who are athletes have a naturally lower resting heart rate and blood pressure. The dive reflex was tested on both athletes (defined as a university varsity collegiate student athlete) and non-athletes (defined as an university student not involved in a varsity sport) by immersing their faces into 20°C and 4°C water. For each submersion individual's heart rate, blood pressure, QRS complex and respiratory rate were measured and then analyzed to determine if there would be any difference between cardiac and respiratory function between these two groups during a simulated dive reflex.

P312 - Tensile Strength Comparison of Long Muscle/Short Tendon Units to Short Muscle/Long Tendon Units

Sara Glendinning, Kasey Grant, Anna Lee Travis

Anderson University, Anderson, SC

Skeletal muscles and tendons work together under the control of the somatic nervous system to allow regular movement of the skeleton or skin. The specific tensile strength of these structures is significant to the ability of an organism to move, because these structures use applied force and elasticity characteristics to allow enough motion but not excessive. Excessive force can potentially stretch these units too far causing irreparable damage to the units themselves or the joints over which

they operate. To collect data on both muscles and tendons and their respective stiffness a Young's modulus of elasticity can be used. This measures the tensile strength of the muscle and tendon. In this research, the muscle tendon complexes (MTCs) were excised, a Young's modulus apparatus was developed, and the change in length of the MTC as weight was added was measured. Eight muscles were chosen and classified two groups-short muscle/long tendon and long muscle/short tendon- based on the tendon length compared to the length of the entire muscle/tendon unit. The two groups were then placed under force analysis to obtain the Young's Modulus of Elasticity for each in order to analyze the ability of the unit to recover from stress applied to the unit. The results showed no significant difference in the tensile strength of either muscle/tendon grouping.

P313 - Differential Effects of Non-Associative and Associative Learning on Neuronal Activity in Mouse Gustatory Cortex.

Stephanie Staszko, John Boughter, Max Fletcher

University of Tennessee Health Science Center, Memphis, TN

Conditioned taste aversion (CTA) is an associative learning paradigm which pairs a taste stimulus with gastric malaise induced by the salt lithium chloride (LiCl). LiCl-taste pairing results in robust learning whereby animals will nearly completely avoid the conditioned stimulus post-learning. A major drawback of CTA learning studies has been the inability to reliably follow individual cell taste responses across days, making it unclear how taste representations change with experience. Our research utilizes miniature head-mounted microscopes (miniscopes) to investigate taste coding in the gustatory (taste) cortex (GC) of awake, behaving mice. A primary benefit of this technique is the ability to image calcium activity of the same population of neurons across multiple days in deep brain regions. Thus, our present research aims to understand how non-associative and associative learning alter activity of single cells in mouse GC. In this paradigm, mice are water deprived and trained to lick stimuli from a Davis Rig, which allows for automated stimulus presentation and lick detection. Animals are then exposed to a panel of the five basic tastes, receiving two random presentations of each stimulus daily over the course of five days. In this non-associative learning paradigm, animals increase consumption of preferred tastes and decrease consumption of non-preferred tastes as stimuli become familiar. Next, animals enter a CTA paradigm in which they consume LiCl from a sipper tube and are tested for learning the following day with presentations of sodium chloride and diH2O, with low sodium chloride consumption reflecting learning. Results show distinct populations of taste-responsive and non-taste responsive cells within GC, with a clear decrease in activity of non-taste responsive cells after non-associative learning. In contrast, associative learning results in an increase of GC activity in response to sodium chloride consumption. Current analyses are focused on understanding changes in single cell activity following CTA.

P314 - Response to Vibrational Stimuli in Cottus carolinae and Carassius auratus

Jennifer Kolwicz

Columbus State University, Columbus, GA

The degradation of natural environments has accelerated in recent years in response to the expansion of human activities. One frequently overlooked, but important aspect of the environment is the natural soundscape. Anthropogenic noise is on the rise in both terrestrial and aquatic ecosystems, and several studies have revealed this disturbance to have negative impacts on the overall health of animals. Anthropogenic noise may not impact all species equally, as both hearing sensitivities and noise levels may differ between species, and between habitats. In freshwater systems, common sources of anthropogenic noise are bridge crossings. Recent studies have shown that trains passing over streams can produce vibrations in the substrate. Benthic fishes such as sculpin, gobies, and darters often perch themselves on the substrate using their pectoral fins and may be more susceptible to ground-borne anthropogenic noise than pelagic fishes that rarely come into contact with the substrate. Background noise in freshwater systems, in addition to anthropogenic noise, contributes to the limited effectiveness of far-field signals, thus leading to the utilization of vibratory signals to communicate. This study uses an electrophysiological approach to determine whether a benthic fish species (Banded sculpin) shows greater sensitivity to ground-borne vibrations than a pelagic fish species (Goldfish).

P315 - The effect of cannabidiol and lamotrigine on action potentials in earthworms ventral giant fibers and sciatic nerves in frogs and mice.

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Cannabidiol has been shown to cause inhibitory effects on sodium currents primarily through altering the biophysical properties of cell membrane, promoting the inactivated conformation of sodium channels. Therefore, cannabidiol would possibly block the nerve impulses in all three species proposed to use. Lamotrigine is also known to block sodium channels but it is not known whether its effects are extracellular or intracellular origin. With the use of earthworms, frogs, and mice, we hypothesize that single fibers (in earthworms) may respond differently (in nerve impulse amplitude and conduction velocity) compared to nerves in frogs and mice in that their neurons are bundled together to form nerves. In addition, we will alter the concentrations of Cannabidiol and Lamotrigine to identify the threshold for action potentials in each species. With the use of nerve chambers, we are hoping to elucidate this unknown mechanism. The nerve fibers of three species will be placed in a nerve chamber (IWorx AHK214 Physiology Kit) to record their action potentials including conduction velocity of the nerve under different concentrations. Likewise, the action potential and conduction velocity of the nerve will be recorded after nerve fibers have been immersed in cannabidiol or lamotrigine solution, respectively, for either 30 or 60 minutes. A custom-made Faraday cage will cover the nerve chamber which will reduce any electromagnetic interference for all three species. We are currently collecting data at this point and will present our results in the annual meeting of ASB in Memphis.

P316 - Cannabis-Induced Neuroplasticity in the Dopaminergic Reward System

Brandon Stewart

Kennesaw State University, Kennesaw, GA

As laws for cannabis loosen, likelihood of cannabis exposure increases throughout the lifespan of a human. The most profound effects of cannabis exposure are expected in the developing brain that relies on balanced signaling to establish circuits that underlie behavior, learning, and memory. Any chemical disruption of circuit development yields long term consequences for the function of behaviors produced by the action of these circuits. Even after circuits mature, signaling proteins among these neurons can be altered by chemical exposure. Our present study is attempting to determine neuroplastic changes in the adult brain after acute and chronic exposures to the cannabinoid, delta-9 tetrahydrocannabinol (THC). With the zebrafish model, we focus on behavioral and circuit-level changes in dopaminergic reward pathway-like circuits governing motivation, locomotion, learning, and memory in vertebrates. To analyze the effects of acute THC exposure, adult zebrafish were subject to a ten-day conditioned place preference (CPP) paradigm over which zebrafish established a preferred tank compartment, then, over a four-day period, were given cannabis injections that were paired with placement of the fish in the non-preferred compartment. During final place preference, fish injected with THC showed significant preference for non-preferred, THC-paired compartments compared to control fish subjected to vehicle-injections paired with placement in non-preferred compartments. Our data also indicate significant interactions of the anesthetic, tricaine methanesulfonate, on preference, leading to a non-chemical anesthetization protocol for CPP experiments. Without the anesthetic, THC-exposed fish showed significant change in place preference compared to controls. Our next steps will explore the neuroplastic changes that underlie dopaminergic signaling that drive these experiential learning behaviors. Previous studies investigating the effects of the CNS stimulant, d-amphetamine on CPP and dopaminergic neuronal changes indicate that d-amphetamine exposure significantly interacts with experiential learning, and those behavioral changes accompany significant increases in dopaminergic signaling within homologous striatal and mesolimbic pathways.

P317 - Therapeutic hypothermia for the preservation of residual hearing following cochlear implant surgery

Nina Latorre

The Honors College at Miami Dade College, Miami, FL; Bridge to Baccalaureate Program with the University of Miami, Coral Gabels, FL

Cochlear implants (CI) are neural prostheses that replace lost hearing function in patients. However, the implantation procedure results in irreversible damage to the sensorineural cells within the cochlea and a loss of residual hearing. In the present work, we tested the safety and efficacy of mild localized hypothermia to preserve hearing function following CI surgery in a rat model. We believe that therapeutic hypothermia has the ability to conserve residual hearing and enhance hearing safely during invasive CI surgery. Animals were divided into three groups: 1) normothermic CI; 2) hypothermic CI; 3) hypothermia without CI with the contralateral cochleae used at controls. Therapeutic hypothermia was provided during CI following a protocol previously established in the laboratory. The goal of this procedure was to reduce the temperature of the cochlea by ~4-6ºC before and after CI surgery. For comparative results, we used the contralateral ear that received neither hypothermia or trauma. To show its safety, a group of rats only received hypothermia. Auditory brainstem responses were recorded at different frequencies in anesthetized rats to assess their hearing function prior to surgery and at increasing intervals after the treatments. To correlate function to structure, we used immunohistochemistry of excised cochleae to count inner and outer hair cells. The results show that normothermic group had a significant loss of residual hearing following CI. In comparison, the hypothermic CI group had a significant gradual recovery in hearing thresholds starting at day 2. Overall, the results suggest that mild therapeutic hypothermia, applied locally before and after CI surgery, preserves significant hearing function.

P318 - Stress and College Students: The Impact of Nature and Tree Climbing

Sophie Willihnganz

Warren Wilson College, Asheville, NC

Shinrin-yoku, the concept of spending time in a wooded area or green space, or 'forest bathing', promotes overall well-being and decreased stress (Park et al., 2010). Driven by an interest in mitigating college students' stress due to its negative impact academic success and physical and mental health, this study investigated whether recreational tree climbing, as modified forest bathing, could similarly reduce stress in a college demographic. Twenty participants engaged in two climbing conditions for prescribed periods of time, with recreational tree climbing as the intervention and wooden tower climbing as the control. Participants' stress was measured pre- and post-climbing for both conditions by completion of a self-reported survey to measure perceived acute stress, and physiologically via measuring heart rate, electrodermal activity, salivary cortisol concentration, and alpha brainwave activity levels. Results were significant for reductions in stress levels of college students post recreational tree climbing as measured by perceived acute stress, heart rate, and electrodermal activity. Additionally, alpha brainwave activity, a measure of stress absence, was significantly lower in the tree climbing group compared to the tower climbing group. Further study will provide additional insight into the potential of recreational tree climbing to provide a low-cost, accessible way for college students to manage stress. Key words: brain wave activity, college students, cortisol, stress, recreational tree climbing

P319 - Centrum morphology, age, and growth of Cretalamna sp. (Lamniformes, Otodontidae), a shark, from the Cretaceous Mooreville Chalk Formation (Santonian to Campanian), Alabama

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Cretalamna is an extinct shark from the order Lamniformes (mackerel sharks), a group containing, e.g., the white sharks today, and the family Otodontidae (and several other extinct families), which is the same family containing iconic *Carcharocles megalodon*. We know the taxa of the Otodontidae from their teeth, but have a very poor understanding of somatic morphology and biology. Our objectives are to describe centrum morphology and age and growth biology of *Cretalamna*. The centra of two, extremely rare, disarticulated, but associated specimens of *Cretalamna* were examined from the Late Cretaceous Mooreville Chalk Formation (Campanian age) of Alabama. Centra from each specimen were photographed, hemisected, and transverse-sectioned to study morphology and their age and growth. The age was estimated by counting dark rings presumed to be annuli. Radial distance (mm) was measured from the notochord foramen to each annulus to build a growth profile. Centra are round, much taller than long, and contain moderately robust, bifurcating, radial lamellae that extend from the notochord foramen to the distal margin. No circular lamellae are present. The

corpora calcarea are moderately robust. Centrum ages are estimated to be 12 and 13 years old for the two individuals. The growth profiles are relatively linear and show no sign of old age. Sexual maturity probably occurred after 9 years old when somatic growth was beginning to slow indicating the tradeoff between somatic and gonadal growth. The birth rings of *Cretalamna* were nearly the same size as those of *Lamna nasus* (Porbeagle shark). *Cretalamna* centrum birth rings were 2.7-3.8 mm while *Lamna nasus* ranged from 3.0-5.5 mm. Our research suggests this taxon of *Cretalamna* was likely an active and fast swimmer because of the robust nature of the centra.

P320 - Larval zebrafish as an in vivo model to study gut motility disorders

Tierney Daw, Mary Kinkel

Appalachian State University, Boone, NC

This research focuses on understanding how human gut motility disorders arise from developmental defects of gut patterning. Several zebrafish lines exist for modeling specific genetic mutations that disrupt gut motility. Our goal is to extend these genetic studies by developing the larval zebrafish as a model for studying gut motility. Larval zebrafish offer advantages as a model, including transparent body walls and a straight gut tube, that allow relatively easy imaging ofthe gut contents in live fish. We have determined that a meal of brine shrimp is highly visible through the body wall of young larvae. We have also found that larvae eat brine shrimp as early as 5 days post fertilization (dpf) and the majority of larvae ingest shrimp by 9 dpf. Gut imaging and gut transit assays can therefore be performed within the first week of larval life, making zebrafish a convenient tool for studying defective gut motility. We present preliminary results from performing a gut transit assay on young wild-type larvae. We hypothesize that this assay will be useful to better understand how genes function in healthy gut motility in larvae. Future studies will focus on using the assay to compare gut function in healthy wild-type and mutant zebrasfish, providing clues to the genes and mechanisms involved in intestinal development and motility.

P321 - Preliminary comparison of effects of Apple Snail Extract to Xenopus laevis and Ambistoma maclatum

Andrew Shirley, Johnny Ubi, James Rayburn

Jacksonville State University, Jacksonville, AL

The Island Apple Snail, *Pomacea insularum,* is a freshwater invertebrate that has invaded the United States from South America. It is an agricultural and ecological pest as it fouls the water it inhabits and consumes plants such as rice voraciously. *P. insularum* lay eggs weekly, with clutches containing up to 2000 eggs. The casings on these eggs contain a protein that has been shown to be neurotoxic to mice when consumed, causing paralysis to limbs and death. One method for controlling the population of *P. insularum* is to scrape the egg masses from the surface they adhere to, allowing them to fall into the water. This may allow the toxic protein to diffuse into the surrounding environment, especially if the eggs are crushed. *Xenopus laevis* and *Ambistoma maculatum* embryos were treated with raw protein extract, in order to compare toxicity between the two species. *X. laevis* eggs were spawned and fertilized in the lab, jelly coats were removed, and unfertilized individuals were removed. *A. maculatum* eggs were harvested from the field and removed from their outer jelly coat before exposure to unfiltered protein extract. These individuals were exposed to an extract from *P. insularum* eggs at varying concentrations. *X. laevis* eggs were held at 24ºC and monitored over a 4 day period for mortality. *A. maculatum* Eggs were held in conditions like *X. laevis* for 12 days while being monitored for mortality. Malformation assessments and length measurements were performed at the end of each experiment. Data collected was used to calculate LC50, EC50 malformation, and a minimum concentration to inhibit growth. Data were analyzed by two-way ANOVA in SYSTAT. These results suggest *X. laevis* may be more sensitive to egg toxin than *A. maculatum.*

P322 - A Preliminary comparison of the developmental effects of Pomacea maculate egg extracts to embryos of Xenopus laevis.

Johnny Ubi, Andrew Shirley, James Rayburn

Jacksonville State University, Jacksonville, AL

Pomacea maculata, of the family Ampullariidae, have been a popular inhabitant of many household aquariums for decades and have since become established in certain wetlands due to its release.

This Apple snail has been introduced to multiple areas around the world and are considered highly invasive. A toxin has been reported in the eggs and egg case that may be potentially dangerous to their neighboring aquatic species. Our aim was to evaluate a protein extract from the eggs/egg cases and determine its toxicity and teratogenicity to *Xenopus laevis* (African clawed frog) embryos over time. The protein from this apple snail was extracted by homogenizing the sample and centrifugation at 3000 G for 30 minutes and collecting the supernatant. The extracted protein in the supernatant was then frozen until used. To examine the potential effect time at 24 degrees C may have on the Xenopus embryos, multiple sets of supernatant were thawed at 24 degrees C for different amounts of time up to 96 hours and then refrozen. Each of the thawed supernatant samples were then tested. Normally developing embryos were selected. They were then divided into groups of 20 and placed into individual 40 mm sized pertri dishes . Each dish contained eggs, a specific concentration of egg protein toxin, and FETAX solution. The solution was replaced in each daily for four days. Each day the pH of the solution and a survival count were recorded. After 96 hours, pH, survival, malformations, and embryo length were recorded. The LC-50(lethal concentration required to kill 50% of a given population), EC-50(effective concentration required to cause malformation 50% of a given population), and a Teratogenic Index (TI) were then calculated. TI is calculated by dividing LC-50 by EC-50. A comparison of the extracts were conducted and showed differences in developmental toxicity.

P323 - Studying the effect of chromosomal content on posterior progenitor cells in zebrafish embryos

Elsie Rodriguez, Cortney Bouldin

Appalachian State University, Boone, NC

Embryonic stem cells are undifferentiated cells that can, through proliferation and differentiation, give rise to all cell types in a multicellular organism. As cells become more differentiated, highly potent stem cells transition to germ layer intermediates that become lineage restricted progenitors and ultimately become terminally differentiated cell types. Posterior progenitor cells, essential for body formation in vertebrates, are held in the G2 phase of the cell cycle during posterior axis elongation in zebrafish. Following S phase, G2 phase cells have duplicated cytoplasmic material, along with double the DNA content. Polyploid cells have been shown to be involved in regeneration, genomic buffering against mutation and resistance to apoptosis. Cells held in G2, with double the DNA content, might be mimicking benefits seen in polyploid cells. To explore this hypothesis and examine the connection between differing DNA contents and posterior progenitor cell differentiation, haploid and diploid zebrafish were generated via in-vitro fertilization. The genes *tbxta, tbx16, tbx16l*, and *myoD1* are mesoderm specific genes that have explicit domains of expression in differentiating progenitors. To date, we have used in-situ hybridization with a probe for the gene *tbxta* which is expressed in the least differentiated posterior progenitors as the body forms. Across haploid and diploid zebrafish, the staining for *tbxta,* shows varying domains of expression at 16 hours post fertilization. More specifically, split notochords and less *tbxta* expression at the tip of the tailbud were observed. Haploid zebrafish raised to 5 days post fertilization also exhibit shorter and thicker bodies with curved tails. Therefore, less DNA content may hinder a posterior progenitor's ability to remain undifferentiated. This could be attributed to a smaller population of progenitors or a lack of buffering against mutations. Future directions include an investigation of additional mesoderm specific genes and a comparison including tetraploid zebrafish.

Beta Beta Beta Oral Presentation Abstracts

BBB Oral 1 - Synergistic Antibiotic Treatments in Acinetobacter baumannii

Ashley Murphy

Columbus State University, Columbus, GA

Acinetobacter baumannii is a gram-negative, coccobacillus bacterium that is resistant to many classes of antibiotics. *A. baumannii* causes diseases and infections such as urinary tract infections (UTIs), pneumonia, meningitis, and wound infections. Many infections caused by this bacterium originate and spread within hospitals, making it one of the most prevalent nosocomial pathogens. Possible sources of infection that end up causing outbreaks include preinjury skin colonization and introduction from the environment at the time of the injury. Transmission of infection within a hospital can occur via acquisition after injury during treatment in hospitals, as well as the contamination of the hospital environment and indwelling devices such as catheters and respirators. This project explored the sensitivity of clinical isolates of *A. baumannii* to antibiotic combinations using levofloxacin, polymyxin B, minocycline, and colistin via a microdilution method. These antibiotics were interchangeably tested in different combinations on four clinical strains of *A. baumannii* obtained from St. Francis Hospital in Columbus, Georgia. All four strains were resistant to most combinations of antibiotics. One specific combination of antibiotics consisting of polymyxin B and levofloxacin resulted in sensitivity against two of the four strains. This suggests that the antibiotic combinations are strain dependent. Other antibiotic combinations need to be conducted to further elucidate antibiotic synergy in treatment of *A. baumannii*.

BBB Oral 2 - Optimizing Primary Microglia Isolation and Culture

Deanna Doughty

Augusta University, Augusta, GA

Glioblastoma (GBM) is the most severe form of brain cancer and the most common adult subtype. Most patients with GBM survive less than one year and survival past five years is very rare. Part of what makes GBM so aggressive is its tumor microenvironment, which is made up of cancer cells, and other cells such as immune cells, which are recruited to the tumor during tumor proliferation. One type of immune cell commonly associated with the microenvironment is the macrophage, which should detect and destroy foreign material, including cancer cells. Macrophages which protect the brain are called microglia. In a cancerous environment, the tumor is able to communicate with the microglia and transform the cells so they are no longer tumoricidal. They instead become tumor promoting and encourage angiogenesis and metastasis. The long-term goal of this research is to co-culture GBM cells with microglia lacking the NF-κB pathway to better analyze the role of the pathway in tumor progression. Before this can be accomplished, the best method for isolating primary microglia and growing them *in vitro* had to be optimized. Microglia are very delicate and do not survive long, which makes their isolation difficult. To overcome this, multiple isolation methods and cell culture conditions were tested for optimal cell yield, health, and phenotype. Cell death was quantified prior to plating to determine whether cells were dying due to the isolation procedure or culture conditions. A hybrid method combining enzymatic homogenization from magnetic bead antibody cell separation and 70%/90% Percoll gradient yielded the highest number of healthy, naïve cells when using cells from mice ~ 1 week old. In addition, cells cultured in neurobasal media/ 10% B27/ 5% glutaMAX/ 5% Pen-Strep on poly-D-lysine coated wells had increased survival and exhibited more favorable morphology over the published DMEM/ 10% FBS.

BBB Oral 3 - Production and characterization of a microglial NF-κB deficient animal model

Michael Goodall

Augusta University, Augusta, GA

Glioblastoma (GBM) is the most invasive type of brain cancer with an extremely low 12-month survival rate. Unfortunately, there is no known cure or successful long-term treatment. Microglia, immune cells of the central nervous system, are recruited to growing GBM tumors during the initiation stage and can increase aggressive properties. As such, large numbers of microglia are associated

with poor patient prognosis in GBM. There is evidence that the nuclear factor-kappaB (NF-κB) pathway is involved in microglial interaction with GBM cells. To better understand the role of microglial NF-κB in GBM, we have created a transgenic animal model which lacks the p65 transcription factor of the canonical NF-κB pathway, specifically in microglia. To make this model a p65fl/fl animal was bred to a Cre recombinase model which is under the control of the microglial specific promoter CX3CR1, as well as tamoxifen regulation. Punnett squares were used to determine the best possible breeding schematics based on potential percentages of obtaining homozygous offspring. PCR (polymer chain reaction) based genotyping was used to determine the genotype of each mouse. We are currently utilizing intracellular flow cytometry on the established homozygous p65fl/fl/CX3CR1CreER mice line and have begun initial testing for tamoxifen efficiency ofinduced microglial p65 deletion.

BBB Oral 4 - Investigation of the toxicological effects of CNT-Ab in mice following microwave hyperthermia.

Andrew Mixson, Moses Kusi, Amy Chall, John Stagg, Wilmot Gissendanner, Austin Rawlings, Mernyse Bruce

Georgia Southern University, Statesboro, GA

Serious side effects and treatment resistance are the main impediments to successful cancer therapy. Carbon nanotubes (CNTs) conjugated to antibodies offer a method to deliver localized, site-specific treatment while diminishing or eliminating impediments found in other forms of treatment. In previous microwave therapies, healthy and cancerous cells were likely to undergo the same heating. The current treatment seeks to make use of the high microwave absorption properties of CNTs in conjunction with anti-PSMA antibodies (Ab) to provide localized thermal ablation at the cellular level *in vivo*, minimizing treatment side effects and damage to healthy tissue. We seek to validate the initial promising results by characterizing CNT-Ab distribution, clearance, and toxicology in mice following microwave hyperthermia. To accomplish research objectives, 4-5 weeks old male mice were assigned to 8 groups of 6 per treatment. The mice were injected with CNT-Abs subcutaneously into the right and left flank of the mice. Mice were microwaved at 150 watts for 5 seconds. After 2 weeks, blood was collected to assess the effects of CNT-Abs *in vivo* and analyzed for albumin, total protein, aspartate transferase (AST), creatinine levels in the serum, and select genes were analyzed in the liver and brain. There was no significant difference in levels of albumin, total protein, and creatinine. AST activity was increased in two treatment groups. Expression of PTGS2 was elevated in the brain. In the liver, TNF-α was significantly expressed in certain treatment groups. These results seem to suggest appears exposure to CNT-Ab, microwave, and CNT-Ab plus microwave produced varied results depending on the treatment regimen. The project is still ongoing to analyze histopathology of the liver, kidney and brain, and inflammation and oxidative stress genes in the kidney.

BBB Oral 5 - Herbicide toxicity to nontarget aquatic organisms does not increase in mixtures with surfactants

Courtney Telfort

Georgia Southern University, Statesboro, GA

Herbicides used for weed control enter aquatic environments after rain events where they interact with microscopic aquatic plants (phytoplankton) and animals (zooplankton) that form the base of aquatic foodwebs. Atrazine is an herbicide with low solubility in water. Therefore, to improve application and effectiveness on weeds, it is often mixed with surfactants such as alkyl polyglucoside (APG). Although APG itself has low-toxicity, a drawback to increased atrazine solubility is greater potential to adversely affect aquatic organisms, particularly phytoplankton. We hypothesized that atrazine and APG negatively affect plankton abundance more than atrazine alone. Specifically, we predicted phytoplankton abundance should 1) decrease with increasing concentrations of the mixture compared to the same atrazine concentrations individually, and 2) decrease more in the presence of zooplankton grazers that consume phytoplankton. The responses of green microalgae (*Chlorella* sp.) to atrazine with or without APG and with or without zooplankton grazers (*Daphnia magna*) were examined over 2 weeks in freshwater microcosms. First, *Chlorella* sp. received one of four concentrations of atrazine (0, 1, 5, or 25 μgL^{-1}) with or without APG (8 treatments; n=5). In a second experiment, *D. magna* were also added to each microcosm. Phytoplankton and *D. magna* abundance were measured. Only the highest concentration of atrazine decreased cell density, independent of APG addition. Surprisingly, mixing APG with low and medium concentrations of atrazine either had no

effect or appeared to reduce the toxicity of atrazine to *Chlorella* sp. The presence of grazers generally decreased *Chlorella* sp. abundance. However, increasing atrazine concentration adversely affected *D. magna* abundance both alone and in mixture with APG. The results of this experiment suggest that high concentrations of atrazine in runoff from agricultural fields decrease the abundance of nontarget planktonic organisms and mixing atrazine with APG does not appear to increase atrazine toxicity.

BBB Oral 6 - Predicting Colony Recognition in Argentine Ants, Linepithema humile

Katherine Barrs

Georgia Southern University, Statesboro, GA

Argentine ants, *Linepithema humile*, are a globally invasive species that displaces native species and facilitates agricultural pests. Ants in introduced populations found in California form expansive supercolonies, hundreds of square kilometers in size, with few or no territorial boundaries. Despite their extended geographic range, supercolonies still interact aggressively with other supercolonies. This aggression is based on differences in cuticular hydrocarbons (CHCs) between colonies. Each supercolony is genetically distinct resulting in unique combinations of CHC components that form their specific CHC profile used in colony recognition. The CHC profiles of certain colonies contain over 70 chemicals, but it is unclear which components of this profile are most important for recognition. In this study, we propose the development of a chemical index to be applied to CHC profiles to predict the behavioral response of Argentine ants. Chemical indices are one of the main tenets of chemical graph theory, a mathematical tool for describing chemical structures. Chemical indices assign a numerical value to a graph structure which often correlates with the chemical's properties. Using previously collected data, we plan to analyze the known chemical components of CHC profiles. Then, we will refine our chemical index and apply it to CHC profiles from previously untested colonies collected in the Southeast. This will generate a colony recognition prediction which can be verified through behavioral assays. Overall, we expect our finding to contribute to better understanding of colony recognition and may inform efforts to stop the spread of these highly invasive insects.

BBB Oral 7 - Investigating the Effectiveness of the Antioxidant Catechin Hydrate on Artemisinin Activity in vitro

Wyatt Zander

Catawba College, Salisbury, NC

The malaria parasite, specifically *Plasmodium falciparum*, is among the most deadly parasites known to humankind. Even in the face of emerging resistance, one of the most effective treatments against the malarial parasite is artemisinin (ART), also known as artesunate or qinghaosu. The method by which ART kills the malaria parasite is still in question, although several mechanisms have been proposed which include invoking a molecular stress response within the cell, protein alkylation or lipid peroxidation following ART activation with heme. To further understand if the mechanism by which ART kills the parasite involves peroxidation of lipid, the potential inhibitory effects of the antioxidant catechin hydrate on the activity of ART via an *in vitro* assay system were investigated. The assay, which reacts ART with heme in a lipid environment, has thus far resulted in the generation of a novel fluorescent metabolite that is a hypothesized by-product of ART-heme peroxidation of lipid. Specifically, we proposed that catechin hydrate, a free radical scavenger, would impede formation of the fluorescent product in a concentration-dependent fashion, thus supporting a lethal mechanism by which ART-heme adducts induce lipid peroxidation in the parasite. Moreover, we hypothesize that application of lipid-soluble peroxyl radical scavengers such as vitamin E (α-tocopherol) in this assay system would inhibit the generation of the novel metabolite, further strengthening lipid peroxidation as a mechanism of action for ART and its derivatives.

BBB Oral 8 - Stressor Interactions of Acid and Radiation in Native and Invasive Lonicera

Alexander Wharton

Belmont University, Nashville, TN

Higher concentrations of UV-B radiation and more frequent occurrences of acid rain are apparent plant stressors: the result of human activities dating back to the mid-20th century and the resulting mass release of chlorofluorocarbons and sulfur dioxide into the atmosphere. The delicate intricacies

of photosynthetic processes in plants are largely affected by changes in these two variables, radiation and acidity. More specifically, the effects of these pressures on carbon dioxide assimilation of Tennessee-native *Lonicera sempervirens* and the invasive *Lonicera japonica* are unknown. The purpose of this research is to observe the impact of these stressors on the net CO_2 assimilation rates of the two species of honeysuckle and the resulting synergistic or antagonist effects of the stressors when combined. Each species was exposed to various stress combinations under the constant conditions of a growth chamber, and the net CO_2 assimilation rate was measured with a *LICOR 6400XT*. The results showed no significant variation in assimilation rate between the two species of honeysuckle. Individually, acid treatments showed no significant difference from the control, but radiation treatments resulted in an increased CO_2 assimilation rate in both species. Subjects exposed to both stressors simultaneously demonstrated an intermediary difference between the impact of the stresses alone. In conclusion, anthropogenic UV-B radiation has a significant impact on two common honeysuckle species in Tennessee, and these two stressors can now be classified as demonstrating a positive antagonistic interaction. These findings broaden the understanding of the effect of ultraviolet radiation and acid rain on plants found in the Southeastern United States and add to information regarding stressor interactions.

BBB Oral 9 - The Use of Green Roofs by Avian Species and Their Preference in Green Roof Characteristics

Paige Ulrich

Belmont University, Nashville, TN

Green roofs in urbanized settings have become increasingly popular due to the numerous environmental and aesthetic benefits for humans and wildlife. Birds are one of the major urban wildlife vertebrates that show interest in using green roofs. The purpose of this project was to determine the green roof characteristics that birds prefer. Bird occurrences on three green roofs at Belmont University, Nashville, TN were determined through the use of in-person 20-minute observations. Individual bird occurrences, species, and behavior of birds landing on or near green roofs were recorded weekly for two months. Green roofs varied in size and plant species coverage. The larger green roof, with adjacent green roofs and more plant diversity, had the most bird visits. Results from this study can provide information for green roof designers seeking to maximize wildlife use of this urban green space.

BBB Oral 10 - Growth of Andropogon gerardii (Big Bluestem) with 10-10-10 Fertilizer

Daniel Campos

Belmont University, Nashville, TN

Grasslands such as those that contain *Andropogan gerardii,* big bluestem, in the Southeast U.S. have enough plant tissue to provide adequate habitats and nutrition for wildlife. Tall grasses, specifically, serve as good model organisms to study growth trends and benefit the agriculture industry by naturally making soils nutrient-rich. Over fertilizing is a world-wide problem that harms the environment. Excessive nitrogen gets absorbed into the ground and makes its way into bodies of water causing pollution. The damage caused by the fertilizer run-off creates issues by attracting unwanted pests, disrupting wildlife, and even altering the oxygen concentration in the water. The N-P-K (nitrogen, phosphate, and potassium) ratio of 10-10-10 fertilizer is a combination that benefits most plant types without causing fertilizer burn, and is suggested to be an appropriately safe fertilizer to enhance soil nutrition. Given the cost and labor of applying fertilizer to maximize yield, can less fertilizer with a safe nutrient concentration generate better growth results? This study examined the relationship between the growth of *Andropogan gerardii* with the addition of 10-10-10 fertilizer to determine ideal growing conditions. The plants were grown for 48 days with different amounts of fertilizer added: 0.00g, 1.75g, 3.5g, and 5.25g. Plants were measured for growth rate throughout the study, and leaf length and biomass at the end. Results suggest that no strong correlation occurred between fertilizer amount and growth in length, mass, or rate. Furthermore, the results indicate that over-fertilizing *Andropogan gerardii* will not yield more growth. Therefore, it is not beneficial to add large amounts of fertilizer. This study also observed how future experiments can enhance cost efficiency by showing how the growth rate within a one-month period can be dependent on the dose of fertilizer.

BBB Oral 11 - The Effects of Native and Non-Native Plant Species on CO2 Soil Flux Levels in Relation to Bacterial Community Diversity

Samantha Rodriguez, George Bukenya

Belmont University, Nashville, TN

Soil CO_2 flux is a major contributor to atmospheric carbon. While various factors can affect CO_2 flux, the species of plants in the immediate area and the bacterial community can greatly determine carbon exchange between the soil and the atmosphere. The purpose of this project was to determine the levels of CO_2 released from the soil in the presence of native and non-native plant species. A LI-COR 8100A automated soil gas flux system was used to determine weekly CO_2 fluxes in an urban forest in Nashville, TN for four months. Soil temperature and moisture data were also collected. Biolog EcoPlates were used monthly to determine microbial community diversity in the soil at the same location as the CO_2 flux measurements. The relationship between microbial diversity, presence/absence of exotic plant species, and CO_2 flux levels was determined. There were no significant differences between CO_2 levels released in the presence of native and non-native plant species. There were no significant differences in the microbial community diversity between native and non-native plant species.

BBB Oral 12 - Varying 10-10-10 Fertilizer Concentration for the Optimal Growth of Kentucky Fescue (Lolium arundinaceum)

Nicholas Alexander

Belmont University, Nashville, TN

Elk have been reintroduced into Tennessee and Kentucky in hopes of establishing new healthy herds. A main concern is if there are enough natural resources available to sustain a new population. Elk have been known to favor Kentucky fescue, *Lolium arundinaceum,* in all seasons as a nutritional source. Kentucky fescue is a grass that grows well in Tennessee regions, but little is known about how the plant responds to growth in varying concentrations of 10% Nitrogen-10% Phosphorous-10% Potassium fertilizer (10N-10P-10K). In this study, Kentucky fescue was exposed to 0.00g, 1.75g, 3.5g, and 5.25g of 10N-10P-10K fertilizer in an attempt to see which concentration promoted optimal growth. Kentucky fescue was harvested twice to determine length and dry weight. Two phases of the experiment were implemented due to excessive rain fall and death of the first group of planted seeds. Dry weight and length showed a significant difference at all fertilization levels compared to the control. Therefore, it is possible for *Lolium arundinaceum* to increase in mass and length by 10N-10P-10K fertilizer applications. This information could help lead to providing a substantial food source for reintroduced elk herds.

BBB Oral 13 - Conversion of Glycerol to Butanol Using a Continuous Culture of Clostridium pasteurianum

Jonathan Kilroy

University of Alabama at Huntsville, Huntsville, AL

The biodiesel industry produces glycerol as a waste product. Although glycerol is a useful compound, the amount produced far exceeds the market for it, and some biodiesel producers are going out of business because of how costly the disposal of glycerol is. Fortunately, *Clostridium pasteurianum* has the inherent ability to utilize glycerol as its sole carbon and energy source. *C. pasteurianum* preferentially converts glycerol into butanol, which can be used as a fuel additive. This project tests a bioreactor designed to indefinitely sustain a culture of *C. pasteurianum* that continuously converts glycerol into butanol. A continuous culture is achieved by pumping fresh glycerol media into the reactor at the same rate used media is being pumped out. Keeping the two flow rates constant allows the volume of the reactor to remain the same while the bacteria continue to grow and ferment. Four dilution factors were tested and the effects on bacterial growth and butanol fermentation were determined. In each case, a steady state is reached where the bacteria are growing at a rate equal to the rate at which they are being diluted out. Butanol production is consistently higher in continuous cultures than in batch cultures of the same volume, as shown by High Pressure Liquid Chromatography (HPLC) analysis. The concentrations of other minor fermentation products are reduced in continuous culture relative to batch cultures. Bacteria growth, as measured by the optical density at 600nm, remains in the exponential growth phase as bacteria are removed from the reactor.

The death phase typical of a batch culture is never reached in continuous culture as new resources are constantly provided and there is always space to grow. A continuous culture of *C. pasteurianum* is capable of producing high yields of butanol from glycerol while maintaining a large bacterial population.

BBB Oral 14 - Variation in the pulmonary circulation of Necturus salamanders (Urodela: Proteidae)

Alexandra Templin

Jacksonville State University, Jacksonville, AL

Necturus has both gills and lungs, so understanding the cardiovascular anatomy in this genus is important to fully appreciating the evolution and development of lungs. Conventional developmental research suggests that the arteries of the sixth branchial arch give rise to the pulmonary artery. This hypothesis was tested by dissecting the cardiovascular systems of multiple *Necturus* specimens. The pulmonary artery was not located where anticipated (as a branch from the posteriormost branchial artery). This artery has previously been found to bifurcate from the second and third efferent branchial arteries, but in these specimens, the pulmonary artery is absent as a branch thereof. This condition was observed in all specimens that were dissected. It is possible that the pulmonary arteries arise either consistently from another vessel, or that they may branch from various major arteries depending on the individual. Although more work is needed, the results indicate that there is more variability in the branching pattern and development of pulmonary circulation in *Necturus* than previously described.

BBB Oral 15 - First Evidence of Striped Bass Natural Reproduction in the Tennessee River.

Karen Inouye

Samford University, Birmingham, AL

BBB Oral 16 - Treatment of Fungi with Photosensitizers and UVA

Ashley Wentworth

Northern Kentucky University, Highland Heights, KY

Fungi cause a variety of problems in the medical, agricultural, and veterinary fields. Fungi such as *Penicillium*, *Aspergillus*, and *Fusarium* can grow in food products and produce toxins which can be consumed by humans or animals. However, there are many natural compounds that may be used safely in the environment to control fungal growth. Our previous data have demonstrated that combinations of a natural photosensitizer and ultraviolet (UVA) light can reduce the viability of fungal spores. This project analyzes new photosensitizers capable of decreasing spore germination and the vegetative growth of fungi when used in combination with UVA treatment

BBB Oral 17 - Distance and timing of separation between first-order relatives in the raccoon (Procyon lotor)

Jillian Sturtevant[1], Noah White[1], Evelyn Chukwurah[2], John Hisey[1], Michael Kennedy[3]

[1]Lee University, Cleveland, TN, [2]University of South Carolina, Columbia, SC, [3]The University of Memphis, Memphis, TN

In raccoons, the extent of distance traveled by individuals in first-order relative units during wet and dry weather periods is unclear. We examined 839 raccoons captured 1,870 times on six trapping grids totaling to 13.8-km^2 in southwestern Tennessee. Of the 87 distances among individuals within 43 first-order relative units detected by microsatellite genetic analysis, 65.1% were <1,000m but 4.7% were >68,000m. A total of 44 individual first-order relatives were caught during a dry period, and of these, 9 were in pairs caught on the same grid. A total of 99 first-order relatives were caught during a wet period and of these, 37 were in pairs caught on the same grid. The mean distance of separation of individuals within the 43 family units during the dry period was 3,790.46m (n=86) with 30.2% separated by <1,000m, 1.2% separated by >68,000m, and the maximum distance of separation of 80,009.76m. The mean distance of separation of individuals in the 43 family units during the wet

period was 6,204.56m (n=86) with 34.9% separated by <1,000m, 3.5% separated by >68,000m, and the maximum distance of separation of 80,205.58m. The results of a two-way t-test (p=.4949),failed to support the hypothesis that raccoons disperse depending on levels of precipitation. Further study is needed to understand these patterns in order to effectively manage the raccoon- as a major pest species and the primary carrier of wildlife rabies- in the southern United States.

BBB Oral 18 - The Impact of Heavy Metal Pollution from Small-Scale Golding Mining on Microbial Communities

Stephen Won

Birmingham-Southern College, Birmingham, AL

BBB Oral 19 - Pancreatic beta cell dysfunction in response to chronic hyperglycemia is partially mediated by transcriptional downregulation of Gli-similar 3 (Glis3)

Erin Clayton

Beta Beta Beta Beta Pi chapter, Hardin, KY

Blood glucose levels are highly regulated to maintain blood glucose homeostasis within an organism. When blood glucose levels are elevated, the pancreatic β cells produce insulin, which signals the cells of the peripheral tissues to take up circulating glucose. In type 2 diabetes, insulin-resistance develops at the peripheral tissues and the β cells respond by increasing insulin production during a period termed compensation. The period of compensation, however transitions into a period of β cell dysfunction wherein insulin production is dramatically downregulated in the β cells. Prolonged exposure of β cells to elevated levels of glucose can result in β cell dysfunction but the molecular underpinnings of these events, collectively termed “glucotoxicity” remain unclear. We have found that β cells maintained under glucotoxic conditions have a marked decrease in expression of the transcription factor Gli-similar 3 (Glis3), which has previously been implicated in the development of both type 1 and type 2 diabetes. Here we show that knockdown of Glis3 resulted in decreased insulin expression under low glucose conditions and expression of exogenous Glis3 partially rescued insulin expression under glucotoxic conditions. Together, these results suggest that β cell dysfunction in response to glucotoxicity is at least in part due to decreased expression of Glis3. We also demonstrated that Glis3 binding to the insulin promoter resulted in chromatin relaxation while loss of Glis3 under conditions of persistently elevated glucose significantly decreased accessibility to the insulin regulatory region. Finally, we demonstrated that cells exposed to hydrogen peroxide, which induces oxidative stress, caused Glis3 mRNA levels to decrease under normal glucose conditions while treatment of cells maintained under glucotoxic conditions with the antioxidant 4-hydroxy TEMPO rescued Glis3 expression. These results suggest that Glis3 levels decrease under glucotoxic conditions as a result of increased oxidative stress.

Beta Beta Beta Poster Presentation Abstracts

BBB 1 - Structure-to-Function Relationships of Metal Substitution in Lipoxygenase Activity

Claire Fabian-Bayola, Oluwatosin Ayinde, Adam Offenbacher

East Carolina University, Greenville, NC

Lipoxygenases (LOXs) are enzymes that catalyze the (per)oxidation of polyunsaturated fatty acids. In plants, hydroperoxide products of substrate, linoleic acid (LA), are linked to seed germination and development; mammalian LOXs are responsible for both anti- and pro-inflammatory signaling molecules. To initiate these biochemical reactions, most LOXs possess an iron metal center (Fe-LOX), but enzymes from pathogenic Fungi use manganese (Mn-LOX). Despite the large reduction potential of Mn2+/Mn3+(E0~ 1.5 V) versus Fe2+/Fe3+ (E0= 0.77 V) in solution, Fe- and Mn-LOXs exhibit comparable reactivity. Guided by site-directed mutagenesis kinetic analysis and EPR spectroscopy, the importance of the second ligation shells in regulating metal reactivity is being investigated herein. According to our accumulating data, more remote second shell ligands appear to greatly influence the reactivity of Fe and especially Mn in LOX through changes in symmetry, rather than any apparent changes in the metal –OH acidity. Our current and future focus is being placed on

mutagenesis studies of the hydrogen bond network surrounding the Mn metal center in the Mn-LOX from Magnaportheoryzae, a critical plant pathogen.

BBB 2 - A survey of aquatic macro- and micro-invertebrates of vernal granite outcrop pools in North Georgia

Joshua Fuller, Cruz Mejia-Rodriguez, Ana Guimaraes-Ferreira, Margi Flood

University of North Georgia, Oakwood, GA

Vernal granite outcrop pools are small, non-persistent bodies of freshwater that form in granite depression and provide habitat for endemic and endangered plant species. These pools offer refugia and habitat for a number of animal species, many display traits for survival in these extreme ecosystems. There is no scientific literature on what macro- and micro-invertebrates inhabit the North American pools, and one study in Australia published a surveys on granite pools. The Australian study found each outcrop has the potential to host one to several undescribed species. Georgia contains a majority of the granite outcrops of North America, so Georgia outcrops give a good estimate of the total diversity of North American pools. If these pools are acting as refugia for endemic or undescribed species, then our work is imperative in understanding and protecting these vulnerable habitats and organisms. Sampling was done in early spring until mid-summer at 4 locations: Stone Mountain, Arabia Mountain, Panola Mountain, and Thompson Mills Forest Arboretum. A majority of the specimens collected were rotifers, chironomids, and culicids. Abiotic factors (pH, EC, PPM, temperature, nitrates, and phosphates) were recorded, and will be used in future studies to determine how abiotic factors influence community composition. We have identified all organisms to genus and most to species. We have noted two rotifers (*Notholca* sp. & *Lepadella* sp.), and several micro-crustaceans that are promising candidates for new species and warrant closer inspection.

BBB 3 - University of North Georgia Herbarium Project

Samantha Shea, Hannah Umstead, Amber Rittgers

University of North Georgia, Oakwood, GA

A herbarium is a collection of preserved plant specimens that have been pressed, identified, mounted to backing, and stored in. Large herbariums represent most collections available to researchers, however do not include smaller working herbaria due to a lack of digitization. Smaller herbaria face obstacles that include lack of funding and time available needed to process large numbers of specimens. During fall 2017, the University of North Georgia Herbarium Project (UNGHP) was awarded a University of North Georgia Presidential Innovation Incentive Award to alleviate these constraints by providing funding and staffing for the database. The goal of the UNG Herbarium Project is to process, database and record all herbarium specimens into one central network. The plant specimens, some of which are approximately 30 years old, were collected by undergraduate students through academic courses such as Identification of Vascular Flora (BIOL3329K). Herbarium specimens continue to be collected by undergraduate students throughout each academic year. UNG research students, as well as public researchers, will have access to an online which will provide access to properly curated and maintained specimens' representative of the biodiversity within Northeast Georgia. The UNGHP also provides a framework by which new acquisitions can be included seamlessly into the existing natural history collection.

BBB 4 - Cigarette Smoke Exposure Upregulation of Phospholipase A_2 Metabolic Pathway Expression in the Bladder as a Promotor of Tumorigenesis.

Jessica Nix

University of North Georgia, Oakwood, GA

Cigarette smoking remains the leading cause of preventable death and disease in the United States. Despite known risks, 42.1 million Americans continue to smoke, making research into tobacco-related pathologies relevant and necessary. We previously discovered that cigarette smoke exposure leads to tumor progression in the breast via platelet activating factor (PAF) and other phospholipase A_2 (PLA_2) metabolic pathways. In addition, pilot studies in the bladder have shown urothelial cell destruction, promoting a tumorigenic environment. Cigarette smoking has been identified as a primary risk factor for developing bladder cancer, yet the pathways involved remains to be elucidated.

Our results in the breast and the lack of research in the bladder have led us to examine the PLA_2 metabolite, prostaglandin E_2 (PGE_2), cyclooxygenase-2 (COX-2), 15-prostaglandin hydrogenase (15-PGDH), and prostaglandin E-synthase (PGES). We will observe the expression of these proteins in mouse bladder from nonsmokers and long-term smokers via immunohistochemistry. We hypothesize that we will see a significant increase in the expression of the PLA_2 pathway proteins when compared to the nonsmokers via immunohistochemical analysis. Our studies would show for the first-time evidence to support cigarette smoke exposure dysregulation of PLA_2 metabolite pathway. These studies could provide potential therapeutic targets for cigarette smoked-induced tumorigenesis and progression.

BBB 5 - A two-year study monitoring macroinvertebrate assemblages and leaf litter breakdown rates to assess the impact of Dalton State College campus on College Creek

Cody Beavers, Michael Cuprowski

Dalton State College, Dalton, GA

Headwater streams are often heavily vegetated, allowing little light for instream photosynthesis and making leaf litter an important source of energy. Macroinvertebrate feeding behaviors play a key role in the processing of leaf litter and cycling of nutrients. Stressors associated with urbanization have been shown to decrease macroinvertebrate abundance and diversity. A stream's ability to process organic matter and retain nutrients may thereby be affected. This is the second year of a study investigating whether the Dalton State campus has had an effect on the macroinvertebrate community and leaf litter breakdown rate in the stream which passes through it. Potential stressors include non-point source pollutants, channelization, and reduction of riparian vegetation. Sampling was conducted at an undisturbed reference site upstream of campus and a site downstream of campus. Data were collected using a standard leaf-pack sampling method with leaf masses being tracked and all macroinvertebrates that colonize the packs collected and identified to family. In year two, the amount of leaf matter was increased and the time between pulls decreased to accommodate the high rate of breakdown observed in the previous year. Temperature loggers were also added at each site to account for the effect of temperature on breakdown and ash free dry mass was determined to account for mineral deposits that may have accumulated while in the stream. In 2017, our first sampling year, higher macroinvertebrate abundance, better water quality parameters, and a higher leaf breakdown rate were observed upstream. 2018 results are presently being analyzed.

BBB 6 - Phytoremediation of Arsenic (III) Oxide and Sodium Arsenate with Vetiveria Zizanioides

Karla Gomez[1], Jose Acevedo[2], Bryan Lopez[1], Hussein Mohamed[1]

[1]Dalton State, DALTON, GA, [2]Dalton State, Dalton, GA

Arsenic is a naturally occurring element, it can be mainly found in organic and inorganic compounds. Since arsenic is ubiquitous in the environment, humans are often exposed to it in food, water, air, and soil. It can also be found in pesticides, wood preservatives, dyestuff. Another anthropogenic activity such as gold mining and smelting has increased the exposure of arsenic, and since it is not degraded in the environment, it often remains absorbed in soil. This study focused on phytoremediation technique, refers to using plants to remediate contaminated soil, to evaluate the use of vetiver grass (*Vetiveria zizanioides*) in reducing soil bioavailability of two different species of arsenic (Arsenic (III) Oxide and Sodium Arsenate). Vetiver grass is a good candidate for the extraction of heavy metals due to its fast-growing non-invasive properties, its high tolerance to extreme climates and temperatures, resistance to soils high in acidity and alkalinity, and its tolerance to sodicity. A total of 27 mesocosms, which included a control group, Arsenic (III) Oxide, and Sodium Arsenate have been used in the greenhouse in Dalton State College. Each arsenic form had 4 concentrations in 3 replicates of each concentration in additional to 3 replicates of the control group. Over 15-week block experiment, arsenic accumulation has been evaluated throughout the system (drainage, soil, plant roots and leaves), and identifying the biochemical mechanisms behind detoxification of arsenic by vetiver grass using atomic absorption spectroscopy.

BBB 7 - Using cytochrome c oxidase I gene sequencing to identify acorn weevils in north central Alabama

Andres Leon, Malia Fincher, Johnson David A.

Samford University, Birmingham, AL

Due to the difficulty in identifying acorn weevils, a complete understanding of the relationship between weevils and their oak hosts is lacking in Alabama. We have begun the molecular identification of weevils by sequencing a segment of the mitochondrial cytochrome c oxidase subunit 1 (COI) gene. DNA was extracted from larvae that emerged from acorns from six species of oak in north central Alabama. An approximately 660 bp segment of the COI gene was PCR-amplified, cloned, and colonies were sent to GeneWiz (South Plainfield NJ) for sequencing. Comparison with published sequences revealed that weevils were primarily from the genus *Curculio*, with a few from *Conotrachelus*. However, clear species identification was only possible for one sample (*Conotrachelus juglandis*) that shared all 658 bases with a published sequence. Most of the rest of the specimens showed approximately 90% sequence identity with any published sequences, suggesting that the majority of the weevils present in the region either represent new species or species yet to be sequenced. The sequencing project is continuing with the remaining weevil specimens yet to be characterized.

BBB 8 - The Effect of Micro-RNA 200a Targeting PTEN to Inhibit Apoptosis in THP-1 Cells Following a Lipopolysaccharide-Induced Immune Response

Mary Oliver

Mary Baldwin University, Stauton, VA

The phosphatase and tensin homolog gene (PTEN) responsible for regulation of the cell cycle, monitoring migration, proliferation, and signaling apoptosis in cells is triggered in the immune response when our body faces an invading pathogen. Monocytes, among other immune effector cells, offer primary protection against pathogens in the immune system. However, when monocytes become damaged, the following dysfunction can lead to an array of immune disorders and cancers. Currently, the impairment of this physiological system remains largely unclear. In this study lipopolysaccharide (LPS) was used to induce an immune response in THP-1 monocytes by prolonged short term (24hrs) and long term (120hrs) exposure. The growth of cells seeded at a density of $2x10^5$ cells/ml and measured through Trypan Blue exclusion testing was unsuppressed at low dosages (0-10ug/ml) LPS, but was significantly decreased when compared to the control in higher dosages (15-20ug/ml) 120 hours post treatment (P-value <0.05 as shown by ANOVA). Dendritic and macrophage characteristic development was visualized by inverted microscopy. In previous studies miRNA-200a has been shown to be an oncogene in a variety of cancers promoting tumorigeneses by negatively regulating PTEN. Therefore, the kinetics of this endotoxin response remains to be further investigated in this ongoing study by analyzing miR-200a expression by RT-PCR and PTEN protein expression through a Western Blot. Findings discovered in this study will point to another mechanism of endotoxin tolerance and control in monocytic cells. Results can lead to furthering our understanding of monocyte dysfunctions in immune disorders.

BBB 9 - Effects of testosterone propionate on embryonic zebrafish spine development

Sage Wyatt

Mary Baldwin University, Staunton, VA

Testosterone has been identified as a very important regulating hormone for bone development, at all stages of life. For adolescent girls, abnormally high levels of testosterone propionate have been linked to idiopathic scoliosis, a congenital disorder defined by spine curvature. Zebrafish are an ideal animal model to study scoliosis, because teleost fish are one of the only organisms besides humans which exhibit abnormal spine curvature, even without research-motivated induction. If there is a causative relationship between testosterone propionate and scoliosis development, it is important to characterize the phenotype and its genetic basis. Currently, there has not been sufficient literature examining the effects of testosterone propionate on zebrafish development. In this study, we are performing morphological studies on the effect of testosterone in early spinal development. We exposed zebrafish embryos to a 1% concentration of a testosterone propionate saturated in absolute ethanol. Embryos were treated at 2 hpf (hours post-fertilization), 24 hpf, and 48 hpf and allowed to

develop until 5 dpf (days post fertilization). Approximately 90% of embryos in the 2 hpf and 24 hpf treatment trials developed spinal curvature of varying severity, opposed to no spinal curvature expressed in embryos treated with vector controls. An analysis of the gene expression outcomes associated with this effect is currently in progress. A better understanding of testosterone's involvement in curved spinal development will lead to better diagnostic procedures and allow health care providers to prevent possible cases of this disorder in the future.

BBB 10 - Examining the role of Levonorgestrel on the Invasive Behaviour of Human T47D Breast Cancer Cells in a Danio rerio Model

Ascharya Balaji, Melissa Scheiber

Mary Baldwin University, Staunton, VA

Breast cancer is the second most common cancer-related death among women in the United States. In 2018, approximately 266,120 women will be diagnosed with and 40,920 will die from invasive breast cancer. Approximately 83% of invasive breast cancers express the estrogen and/or progesterone receptors. Numerous studies have been conducted to describe the carcinogenic role of estrogen in breast cancer. However, the role of progestin, as a sole carcinogen has not been studied in detail and has been subject to wide debate. Progestin, the synthetic counterpart of progesterone, has been shown to enhance breast cancer by increasing angiogenesis. In current research, we postulate that progestins, such as the widely used Levonorgestrel may foster metastatic behaviour of tumor microenvironments. To test this hypothesis, Vybrant® DiO cell-labeling solution will be used to label T47D breast cancer cells. These cells are being injected into the perivitelline space of FLK1:dsRed2 *Danio rerio* (zebrafish). These zebrafish will then be exposed to Levonorgestrel for a span of 4 days. The injected zebrafish will be soaked in environments containing 0.1, 10, and 100 µM of Levonorgestrel, while a control group with no Levonorgestrel is maintained. After treatment, we will qualify and quantify the phenotypic changes in the breast cancer cells. The temporal-spatial process of cancer cell invasion, dissemination, and metastasis in the living zebrafish body will be visualized under an epifluorescence fluorescent microscope. Metastasis will be quantified to depict statistical significance by using a binomial distribution.

BBB 11 - Proteome Fishing: A Reverse Docking Study

Meredyth Kinsella

The University of Alabama in Huntsville, Huntsville, AL

Frankincense has traditionally been used for medicinal purposes, though it is generally recognized as an essential oil rather than a pharmacological substance. This project sought to better characterize the potential pharmacological uses of frankincense through an *in silico* reverse-docking study using the scPDB database of "druggable" protein targets. Proteins with co-crystallized ligand structures were prepared for reverse docking with SMINA using AutoDockTools. Comparable pharmacophore points were calculated for each ligand using Align-it. Our primary focus was on Cembranoid structures, a major class of compounds found in frankincense. Each cembranoid was docked to each of the scPDB receptor sites, keeping a maximum of 6 low-energy poses. These poses were scored by pharmacophore similarity to each reference ligand. The score used for ranking hits was a function of the Vinardo docking score, the number of pharmacophore points in the cembranoid ligand, and the Tanimoto index of similarity to the co-crystallized ligand. The most common type of protein receptor found was HIV Type 1 Group M Subtype B with 712 hits. The top binding pose of these was Boscartin G docked in place of reference co-crystallized ligand Saquinavir, a known protease inhibitor drug. By fine tuning of the scoring function using pharmacophore alignments, the resolution and reliability of reverse docking should be greatly enhanced over molecular docking alone. Future work includes enzyme assays of HIV-1 protease to confirm if Boscartin G has adequate binding affinity in vitro and to discern if bioavailability of frankincense-based drugs would be sufficient to display an inhibitory effect.

BBB 12 - Food for the Future: A Study of Insects as a Protein Source for Global Food Security

Sharee Riggs

University of Alabama in Huntsville, Huntsville, AL

This study is designed to gain a sustainable, food source containing proper nutrients and protein for future human populations. Then, determine amount required for population size as compared to cattle production. Finally, create a program to inform users the benefits and procedures to meet their daily dietary requirements. Hypotheses: if available protein is increased in an insect's diet then their nutritional value will increase to fulfill a human's daily protein requirements in one serving size or less and if there is a higher protein content, then food created with it will receive higher ratings for taste. If compared and calculated to cattle, then insects will prove more efficient in cost, portion size, and resources. If a program is created to inform users about insects' nutritional value and diet options then people will use this resource. Protein supplements were added to insect's natural diet to increase nutritional value. Insects' protein value increased to fulfill human's daily protein requirement in 1/3 of a serving size. Biuret and absorption spectrometry testing demonstrates this correlation. Insects increased protein, showing a positive correlation to the hypothesis. Week one, protein values doubled and tripled in some species. After three weeks, protein still increased. There was high success increasing the protein value in species of insects chosen. Insects with higher protein were dried, ground and added to brownies. Volunteers rated brownies with insects to control – without insects. Over 55% of participants rated brownies with more protein higher than the control and overall 88% preferred brownies with insects to without, supporting the second hypothesis. Comparing cattle and insects as a food source shows over 90% higher efficiency for insects, confirming the third hypothesis. Insects provide better nutrition with smaller portions, less calories, and reduced cost. Given all information, people were open to adding insects to their diets.

BBB 13 - PCR Detection of Bacterial Contamination in Gastrostomy Foods for Tube Feeding in a U.S. Hospital Setting

Lasata Shrestha, Nisha Bista

Troy University, Troy, AL

Gastrostomy is a surgical process used to insert a tube through the abdomen and into the stomach. This allows patients who have difficulties feeding to be fed directly into their stomach. Two types of food have been used for gastrostomy feeding; blenderized food and commercial formula. Despite the wide use of these two types of food for gastrostomy feeding, it still remains questionable which food is best for the patients, especially in aspects of nutrition and microbial contamination. The research purpose is to detect and identify bacteria in foods used for gastrostomy feeding under safe food handling and tube feeding delivery standards followed in a U.S. hospital.

BBB 14 - Preliminary Investigations of Refuges as a Method to Capture Riverine Crayfish

Tien Anh Quach, Allison Moore, Emma Davis, Tanner Temple

Troy University, Troy, AL

Over 400 species of crayfish inhabit North America, although relatively little ecological and life history information is available for most species. Sampling techniques usually require labor intensive efforts via dip netting and often electroshocking. Trapping methods have shown to be inefficient in obtaining sufficient numbers for inferences about crayfish populations. A polyvinyl chloride (PVC) pipe refuge design was proposed to passively collect lotic species and compare the same design with baited attractants. Refuges were constructed by connecting multiple parallel pipes, using three individual PVC sizes (1.9, 2.5, and 3.1 cm diameters) of refuges at each site. Two sites were sampled twice weekly (one morning and one afternoon sample/week/site) over four weeks during the Fall 2018 semester, and two additional sites were included during the Spring 2019 semester with bait attached to all refuges. In Fall 2018, a mean of 0.76 ind/refuge of Procambarus suttkusi (target species) were collected in morning samples and 0.30 were collected in afternoon samples. Baited refuges sampled following the same regimen and sites in Spring 2019 resulted in a mean of 0.80 and 1.00, respectively. The additional two sites targeting P. versutus in Spring 2019 yielded results of 0.90 and 0.73, respectively. Smaller diameter refuges (1.9 cm) provided more individuals of P. versutus in Spring 2019, usually around two times more than larger diameter refuges. Procambarus suttkusi collections resulted in variations among refuge diameters utilized as refuge, and were likely influenced by the individual size of each crayfish. Future research modifications may compare alterations to bait type, refuge design and/or color, and building larger or more refuges to maximize crayfish collections.

BBB 15 - Explanation of single nucleotide polymorphisms within human MET oncogene microRNA-binding sites

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Single nucleotide polymorphisms (SNP) in the environmental response genes may be associated with various pathologies. SNP within or nearby miRNA-binding sites can enhance or weaken the microRNA-target interaction. We analyzed the presence of validated SNPs within microRNA-binding sites in the 3'UTRs of mRNA encoding the human MET genes. Despite the relatively low polymorphism of MET, 21.1% of the MET mRNA target sites matching to microRNA seed regions harbor single SNP, 2.5% - two SNP, and 0.46% - three SNP. Furthermore, SNP are present within the 25-nucleotide stretch of the 5'-flanking region (one SNP – in 33.1%, two – in 12.7%, three – in 6.9%, four – in 5.9%, and five – in 0.1%), and, with some higher frequency, within the analogous stretch of the 3'-flanking region (33.1%, 12.1%, 5.8%, 5.3% and 0.7% correspondingly). The concerted action of SNP may result in both completely disabled or hyper-functional, including de novo microRNA-binding sites with the following consequences for phenotypic variations and predisposition to cancers.

BBB 16 - Software package for SNPs-microRNAs analysis

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Dynamic programming (DP) is an optimization method as well as a computer programming approach. Its strategy implies breaking down the problem into a set of smaller tasks and solving each of the tasks in a recursive manner. DP has many applications in bioinformatics, particularly, in sequence alignment. Currently, the existing algorithms provide only for the identity-based sequence alignments. The growing number of reports show the development of the so-called complementary alignment algorithms where the interaction of two complementary RNAs (specifically microRNA and its target mRNA) can be assessed in the context of the multiple single nucleotide polymorphisms. The proposed software package is aimed to resolve all the above-mentioned problems, while allowing the user to modify key parameters such as DP is an optimization method as well as a computer programming approach. Its strategy implies breaking down the problem into a set of smaller tasks and solving each of the tasks in a recursive manner.

BBB 17 - The Sucking Louse Fauna of Mongolian Rodents: Host Associations, Molecular Phylogenetics and Description of a New Species

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Knowledge of the ectoparasitic lice associated with small mammals in Mongolia is sparse. Previous data have only been recorded through individual expeditions and collections. Due to terrain and accessibility, numerous regions of Mongolia have not received proper scientific research. This study aimed to screen Mongolian rodents for sucking lice (Insecta: Phthiraptera: Anoplura) to increase the understanding of host-louse relationships for this area of the world. A total of 9 different species of lice were identified from 56 individual mammalian hosts, representing more than 13 genera and 10 geographical locations. Identified lice are assigned to 4 genera and 9 species, including 3 previously undescribed species. The new species include: *Linognathoides urocitelli* n. sp. (family Polyplacidae) from the long-tailed ground squirrel *Urocitellus undulatus*, *Hoplopleura* n. sp. (family Hoplopleuridae) from the Gobi Altai mountain vole *Alticola barakshin*, and *Polyplax* n. sp. (family Polyplacidae) from the northern red-backed vole *Myodes rutilus*. Microscope imaging, including Scanning Electron Microscopy, line drawings, and DNA sequencing were methods used to distinguish and identify the undescribed species. A molecular phylogeny of collected louse specimens is included, representing all major families of Anoplura.

BBB 18 - Stream Macroinvertebrate Comparisons with New Technologies for Body Size Determination

Rachel Prokopius[1,2], Abby Nienaber[1]

[1]Northern Kentucky University, Highland Heights, *KY,* [2]*Karlstad Universitet, Karlstad, Sweden*

Macroinvertebrates function as important decomposers, predators and prey organisms in stream systems, and it is therefore important to understand the energetic contribution macroinvertebrates provide these systems. Energetic content is traditionally calculated by accepted length-dry mass relationships and corresponding caloric values. Due to morphological differences between taxa, linear measurements may not be a highly accurate method of size determination. This study uses digital imaging software to establish surface area-mass ratios for macroinvertebrate taxa found in the Klarälven river basin near Karlstad, Sweden, and the Ohio River Basin in Northern Kentucky. Macroinvertebrates were collected in tributaries of the Klarälven river using kick-seining techniques once a month from December to May of 2018 and analyzed in the Karlstad Universitet research lab. Macroinvertebrates were collected in Four Mile Creek in Northern Kentucky in October of 2018 and January to April of 2019, and the samples were analyzed in a research lab at Northern Kentucky University. Live samples were sorted, identified to genus and imaged using a Motic 5.0MP camera. The samples were either frozen or preserved in ethanol for at least 24 hours and then reimaged. After drying at 50-65 degrees Celsius for at least 24 hours, the samples were weighed using a microgram balance (±0.01 mg). The data were used to generate surface area-dry mass regressions for different macroinvertebrate genera, and regressions from Sweden and Northern Kentucky were compared. Future studies will link regressions to corresponding macroinvertebrate energetic contents. The data collected from river basin tributaries, because of their connection to the main river, can help to describe the macroinvertebrate biodiversity throughout the river basin.

BBB 19 - Determination of Madtom Shelter Preference

Mariah Slaughter

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Madtom catfish, members of the genus *Noturus*, are common in the waters of the Southeastern US. A previous study observed that madtoms in the Green River, Kentucky, preferred to shelter within old mussel shells compared to the rock cervices. A laboratory study on the Carolina Madtom (*Noturus furiosus*), found that they did not utilize mussel shells and preferred rocks as shelter. I conducted a similar laboratory study to determine which microhabitats the Mountain Madtoms (*Noturus eleutherus*) prefer. Shelter preference was determined by offering the madtoms shelter options (rocks or mussel shells) in 10-gallon aquaria. After the animal had acclimated to the tank for 24 hours the tank was inspected, and the animal's shelter choice recorded. Based on results from preliminary trials the Mountain Madtoms selected to use the mussel shells over the rocks. Freshwater mussels are one of the most endangered taxa and are currently declining throughout their range. If madtoms rely on mussel shells for shelter, the loss of freshwater mussels may cause a decrease in madtom populations within Kentucky waterways, negatively impacting the overall ecosystem.

BBB 20 - Exploratory movements of leopard geckos in visual and non-visual environments.

Rob Tracey

Coastal Carolina University, Conway, SC

Most animals rely on familiar visual landmarks to guide navigation, but non-visual cues can guide navigation in darkness or in unfamiliar environments. Visual and non-visual navigation in mammals has been the focus of numerous studies, and this research demonstrates that mammals establish "home bases" to which they frequently return during exploration of a novel environment. This organization of movement suggests the animals are forming a cognitive map, of the environment, but no studies have tested whether reptiles also form this type of map. To gain insight into the cognitive similarities between species, we evaluated the organization of open-field exploration in leopard geckos in darkness and in light. Measures include the number and locations of stops and progressions, distance traveled, and speed of movement. The same organization of exploratory behavior between reptiles and mammals suggests that this behavior may have been established before the evolutionary split of mammals and reptiles ~200mya.

BBB 21 - Effect of steroid hormone treatment on the viability of a glial cell line

Jesse Hunt, Tracee Guthrie, Candice Tate

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Glial cells perform a variety of functions that are critical for the nervous system. Research using glia in cell viability studies can be beneficial in deepening our understanding of specific neuroprotective effects of progestins and estrogens. Progesterone, 17B-estradiol, and estrone are known to have several neuroprotective properties in the CNS, but the specific effects of these hormones on glial cells are not known. The purpose of this study is to understand the effects of progestins and estrogens on glial cell viability and understand how they influence the viability of astrocytes under stress initiated by either epinephrine or hydrogen peroxide. We hypothesized that the hormone-treated cells will have increased cell viability when treated with epinephrine or hydrogen peroxide compared to cells that are not treated with progestins. Preliminary data suggest ethynodiol diacetate does not protect astrocytes from hydrogen peroxide and epinephrine. Preliminary data also shows no difference between treatments of 17B-estradiol and estrone stressed with epinephrine. An analysis of variance and Tukey's post-hoc test will be used to evaluate statistical significance between treatments.

BBB 22 - Presence of Dirofilaria immitis in Carolina dogs and mosquitoes in Southeastern Georgia

Angelica Tumminello

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Canine heartworm disease is caused by the filarial nematode *Dirofilaria immitis*. The nematode is transmitted by at least 25 known species of mosquito vector and primarily affects canids. This project has two main components: 1) to understand which species of mosquitoes are transmitting canine heartworm disease in Bulloch County, Georgia, and 2) to investigate whether certain dog breeds are more prone to the disease than others. Surveillance for heartworm-positive mosquito vectors was conducted in known heartworm-positive canine locations. Gravid traps were set adjacent to each location with fermented hay, water, and chicken manure as bait. This method was implemented so that samples gathered would contain a majority of gravid female mosquitoes as opposed to a method like light trapping, which often also draws many beneficial and non-targeted insects. Traps were set in the evening and picked up in the morning to be returned to the lab. Vacuum trapping was also occasionally implemented in cold weather months, when mosquito activity is low. Species, sex, date collected, trap type, feeding status, and heartworm presence were recorded for each specimen in the lab. Mosquito samples were frozen until deemed inactive, and then either dissected in 0.8% physiological saline under a compound microscope at a total of 400x magnification or used in Polymerase Chain Reaction (PCR) for genetic detection of heartworm. Heartworm status data from local animal shelters and rescues from six surrounding counties were collected and analyzed for patterns among dog breeds. This study will continue through December 2019.

BBB 23 - Microscopic and molecular characterization of a novel planarian in sulfur spring (Blount Springs, Blount County, AL)

Rachel Harvey, Glenna Bridges

Samford University, Birmingham, AL

We have begun characterization of a novel planarian found approximately 30 m downstream from a spring head at Blount Springs, Blount County, AL (33.930, -86.793). The water upstream from this site has high sulfur content and therefore no visible macrofauna. This section of the tiny stream is isolated from waters further downstream since it flows into a second stream with high sulfur content. Therefore, only our target segment of the stream is habitable by macrofauna since both upstream and downstream are high sulfur regions. The planarians collected were whitish in color and approximately 3-6 mm long with a square head and distinct eyespots. The pharynx is located entirely in the posterior half of the body. The planarian shows a three-branched investine and so belongs to order Tricladida. DNA was extracted from worms and mitochondrial DNA (mtDNA) was PCR-amplified using cytochrome c oxidase I (COI) primers as well as several nuclear DNA primers. Amplicons were cloned into *E. coli* and colony sequenced. The top COI BLAST search hits were with *Phagocata gracilis* (family Planariidae)(query coverage 95.4%, pairwise identity 81.7%) and *Obama tribalis* (family Geoplanidae)(query coverage 65.9%, pairwise identity 87.3%) as well at *Cephaloflexa bergi*

(also family Geoplanidae) and other *Obama* species with similar query coverages and pairwise identities. These low-identity matches with known planarians suggest that these worms might represent new taxa. We are continuing DNA and morphological studies in order to clarify the identity of this seemingly unique planarian.

BBB 24 - The Evaluation of Reg1A as Potential Biomarker to Differentiate Inflammatory Bowel Disease

Lydia Rubenic

Lipscomb University, Nashville, TN

The medical field currently lacks a dependable diagnostic tool for Inflammatory Bowel Disease (IBD). Failure to accurately differentiate between Ulcerative Colitis (UC) and Crohn's Colitis (CC) has led to the creation of a category known as Indeterminate Colitis (IC). Because of the lack of knowledge regarding the molecular difference between UC and CC, about 30 percent of IBD patients are left to attempt to care for their symptoms without an accurate diagnosis, leaving them at the risk of receiving inappropriate or ineffective treatments. Our lab previously performed a microarray on UC and CC patient samples to identify potential gene differences that could be used to better differentiate between these two diseases. One of these potential genes was Reg1A. Western blots and qPCR were performed on protein extracted from patient samples to assay for variation in expression of Reg1A in UC vs. CC patients to explore the potential of Reg1A as a diagnostic.Our lab will continue to move forward to further elucidate the location of Reg1A in the tissue by performing Immunohistochemistry (IHC) to further understand the role Reg1A plays in the presentation of Ulcerative and Crohn's Colitis.

BBB 25 - Identification of Glomus (Glomeromycota) mycorrhizae in association with the aquatic plant Isoetes (Isoetaceae)

Kory Ly, Luke Humble, Viridiana Mandujano, Karina Noyola-Alonso

Catawba College, Salisbury, NC

Aquatic plants are known to form a variety of associations with arbuscular mycorrhizae (AM) but those associations are understudied relative to terrestrial plants. The Lycophyte genus *Isoetes* represents an ancient lineage and may provide insight into the evolution of AM associations. Fossil data from the Carboniferous era indicate that the co-evolution of lycophytes and AM is at least 300 million years before present. Only a handful of *Isoetes* spp. have been evaluated for the presence of AM and no studies have been conducted in the New World. We collected several species of *Isoetes* from North Carolina, USA and Sicily, Italy to determine the presence of AM and for comparison of any *Glomus* phylotypes present. We used *Glomus* specific AML1 and AML2 PCR primers to amplify AM fungi from whole root DNA extracts. Preliminary data indicate the presence of Glomus AM associates in 100% of root samples analyzed (n=6) and diverse *Glomus* 18S sequences from several phylotypes. Microscopy showed the hallmarks of AM infection, fungal vesicles and hyphae in all samples observed.

BBB 26 - Using Flow Cytometry to Study Polyploidy in Quillworts (Isoetes) an Enigmatic Lycophyte Lineage

Luke Humble, Kory Ly, Karina Noyola-Alonso, Viridiana Mandujano

Catawba College, Salisbury, NC

The genus *Isoetes* is rife with morphological convergence and a taxonomically challenging lack of morphological characters for field identification. Like many other plant lineages, polyploidy and reticulate evolution are important drivers of speciation in *Isoetes*. Thus, the chromosome complements of *Isoetes* spp. are key attributes for species delimitation. We used a rapid DNA flow cytometry protocol, to generate over 70 novel C-values, a measure of DNA quantity. *Isoetes* taxa were sampled from North America and Europe including different populations and ploidy levels (diploid, tetraploid, hexaploid, and octoploid species). We observed a significant positive correlation between C value and chromosome complement. These results indicate, with some caveats, that DNA flow cytometry may prove to be a useful tool for routine *Isoetes* species identification, systematic work, and population-level surveys of *Isoetes* ploidy level. C-values are proving useful for identifying putative new species without DNA sequencing.

BBB 27 - Antipredatory Behavior of Elimia paupercula, Sooty elimia, in response to Faxionous yahanlidus, the Spinywrist crayfish

Jessica Lenz

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Little is known about the antipredator behaviors of the freshwater snail Sooty elimia, *Elimia paupercula*. To examine antipredator behaviors in Sooty elimia, snails were exposed to chemical cues from the Spiny wrist crayfish, *Faxionous yahanlidus*, alarm cues from crushed conspecifics, or from both crayfish and alarm cues. Controls contained no cues from predators or conspecifics. Experiments were conducted in the laboratory using 38-L aquaria with three replicates for each of the four treatments. Snails were observed and position recorded relative to the treatment stimulus every hour for 24-hours. Snails exposed to crayfish and alarm cues showed greater distances from the stimulus than those exposed to either crayfish alone or alarm cues alone. Snails exposed to alarm cues only or crayfish only were displaced greater distances than the controls. While Sooty elimia displayed predator avoidance behaviors in the laboratory, it is not clear whether or not these same behaviors would be observed in the field. When a stream snail is exposed to predator or predation cues, the stream flow has to be taken into account. Both chemical cues from the predator and alarm cues from conspecifics will be rapidly disbursed downstream and away from the area from immediate risk.

BBB 28 - Canada Geese (Branta canadensis) as Mechanical Vectors of Parasitic Protozoa

Liberty Sheppard[1], George Argyros[2]

[1]Emory & Henry College, Emory, VA, [2]Emory and Henry College, Emory, VA

Birds are known to serve as mechanical vectors for a variety of microorganisms that are infectious to humans. Canada geese (*Branta canadensis*) are migratory waterfowl that are known to vector of variety of pathogens capable of infecting humans by passing them into the environment through their feces. Due to the increase of Canada Geese populations in recreational and residential areas, there is also an increased risk for humans to become infected with the pathogens they carry. This research investigates the presence of *Salmonella* sp. in fecal samples collected from Canada Geese found in North Carolina, Tennessee, and Virginia. A total of 103 samples from five different localities were tested for presence of *Salmonella*. Of the 103 fecal samples tested, 84 (= 82%) were positive for *Salmonella*. As many species of *Salmonella* are zoonotic pathogens, these data indicate a potential public health hazard where human-animal (fecal) contact is possible.

BBB 29 - Potential antimicrobial activity of plant species in the genus Plantago

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The aim of this study was to investigate potential antimicrobial activity of phytochemical extracts of commercially available species of *Plantago*. *Plantago* is a medically relevant genus, with several species traditionally used worldwide to treat inflammation and various infections. Dried leaf material of both species was extracted using a Soxhlet apparatus. Nonpolar (hexane) extracts were obtained from both *P. subnuda* and *P. eriopoda*, as well as a polar (methanol) extract from *P. eriopoda*. Minimum inhibitory concentration (MIC) assays were performed using 96-well microtiter plates against seven different bacterial species (*Escherichia coli*, *Bacillus megaterium*, *Klebsiella pneumoniae*, *Mycobacterium smegmatis*, *Pseudomonas aeruginosa*, *Serratia marcescens*, and *Staphylococcus aureus*). Final results were obtained only from the nonpolar (hexane) and polar (methanol) extracts from *P. eriopoda*. No tests using either *P. eriopoda* extract showed bacterial inhibition. However, tests using the methanol extract have yet to be completed for four bacterial species. Further review of the literature using *P. major* suggests that concentrations used may have been insufficient to exhibit antimicrobial activity. Future studies are planned using extracts from two other *Plantago* species, starting at higher maximum concentrations.

BBB 30 - Prevalence of Healed Long-Bone Fractures in Arboreal and Flying Squirrels

Carley Gunnell

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Museum specimens representing six species of North American squirrels (Sciuridae) were examined for evidence of healed long bone fractures. We hypothesized that the active volant species of squirrels will have more occurrences of fractures compared to arboreal species, because of the risk associated with jumping/gliding from tree to tree in order to traverse the landscape. Of the 1067 specimens examined, 40 (3.75%) exhibited healed fractures in the forelimbs, hindlimbs or ribs. Twenty (50%) occured in the hindlimbs, while eleven (27.5%) represented forelimbs and nine (22.5%) ribs/digits/hips. Flying squirrels, *Glaucomys* (3 species), had the highest occurrence of fractures at 5.2% of specimens examined (N=192). This is most likely due to gliding/landing from tree to tree, which could result in impaction injury to the forelimbs and rib cage. For tree squirrels, *Sciurus* (3 species) 3.4% (20 of 585) showed injury and *Tamiasciurus* (2 species), had 2.1% (6 of 290). Understanding the family dynamics and behavior of tree squirrels and flying squirrels could provide insight to how these individuals are able to recover from an injury. Further research needs to be conducted to provide evidence of the species dynamics that could contribute to survivability after fracture occurrence.

BBB 31 - Disinfestation Methods for Tissue Culture of Sequoia sempervirens

Andrea O'Malley

Erskine College, Due West, SC

Using tissue culture methods on *Sequoia sempervirens* (Coastal Redwood) plants is an effective way to propagate the material. Pieces of the plant including a stem and at least one bud are removed from the source, put through a disinfestation process to remove contaminants such as mold, and placed in media that causes new shoots and roots to form, allowing the new plant to be transplanted into soil. Published protocols vary on effective disinfestation methods for *S. sempervirens*. In this experiment, seven methods of disinfestation were utilized in an attempt to clean redwood material from Abbeville, SC to continue the process of tissue culture. The methods of disinfestation were compared by calculating the percentages of clean material remaining after several weeks. It was shown that using rifampin as an antibiotic yielded the highest quantity of clean material and is therefore the most effective method of disinfestation for tissue culture of *S. sempervirens*. Given its success with *S. sempervirens*, it is possible that rifampin may be useful for disinfestation of other plants.

BBB 32 - Prevalence of Antibiotic Resistance in the Gut Flora (Enterobacteriaceae) of Wild and Domesticated Horses

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A horse's gastrointestinal tract houses a large and diverse microbial community. Antibiotics used for prophylaxis and/or treatment of bacterial infections can lead to the evolution of antibiotic resistance in the horse's gut flora. For this study, fecal samples of wild horses from the Outer Banks, Carova Beach, N.C. were analyzed to determine the prevalence of antibiotic resistance against twelve common antibiotics used in the veterinary treatment of domesticated livestock. We expect the flora of wild horses to be more susceptible to these antibiotics than domesticated horses due to a lower frequency of medical intervention as compared to domesticated horses. We plan to compare degree of resistance of the Carova Beach herd to horses at the Emory & Henry Equestrian Center and the wild ponies of Grayson Highlands State Park, Virginia. We expect the domesticated population to exhibit greater antibiotic resistance due to availability of treatment and human contact. The Carova Beach population was 100% resistant to Bacitracin, Clindamycin, and Penicillin, 4.35% resistant to Ampicillin, 86.96% to Chloramphenicol, and 8.69% to Erythromycin. The population was 100% susceptible to Ciprofloxacin, Doxycycline, Gentamycin, and Tetracycline, and 95.65% susceptible to Vancomycin. These data suggest a moderate degree of exposure of the Carova Beach herd to either antibiotics, or bacteria exhibiting resistance to some of these antibiotics. One possible hypothesis is exposure to drinking water pools contaminated with human feces from septic systems that are periodically inundated during high rain periods in the area of the Outer Banks.

BBB 33 - Removal of Heavy Metals from Polluted Water

Caleigh Eberhardt

Abraham Baldwin Agricultural College, Tifton, GA

Heavy metal pollution has become an increasing problem around the world due to urbanization and industrialization. More people are moving into cities where more factories are being built to keep up with the demands of the increasing population. The factories use and produce several heavy metals, which are not biodegradable and therefore pollute the local water supplies. Heavy metals such as mercury, cadmium, lead, palladium, and cobalt are known to be very toxic or carcinogenic. In order to reduce high levels of heavy metals in polluted water, we are designing a filter made from Graphene Oxide and Diatomaceous Earth (DE) Silica. Graphene Oxide was synthesized through the oxidation of Graphene nano-platelets. The single layer, hexagonal structure of Graphene Oxide, with different polar functional groups, gives it a large surface area which makes it a very efficient adsorbent. When attached to DE Silica, it is even more efficient because the Silica has a uniform, microscopic porous structure that can bind more heavy metal ions. So far, we have synthesized only Graphene Oxide. In our preliminary research, we tested the adsorption of cadmium ion over time on activated Carbon and Silica, separately. We found that carbon is so active, it binds to Cd^{2+} immediately. The adsorption of Cd^{2+} by activated Carbon was independent of time on the scale we used (1 to 60 minutes). On the other hand, adsorption of Cd^{2+} on DE Silica was dependent of time. The level of adsorption of Cd^{2+} increased over time with maximum adsorption at 60 minutes for DE Silica. Carbon was a better adsorbent as compared to DE Silica based on the solutions we used (1000 ppm and 2000 ppm). Our next steps are to synthesize Graphene Oxide attached to DE Silica and determine the adsorption of different heavy metals by the hybrid adsorbent.

BBB 34 - Susceptibility of Microorganisms to *Rhus michauxii* Extract

Francisco Garcia

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Rhus michauxii (Anacardiaceae) is an endangered species of shrub with a disjunct distribution in Florida, Georgia, North Carolina, South Carolina, and Virginia. *Rhus michauxii* is distinguished from other species in the genus by exhibiting a terminally winged rachis, pubescent leaflets, and highly pubescent stems. Other members of the genus, *Rhus,* have exhibited antifungal, anti-inflammatory, cytotoxic, and antimicrobial bioactivities, among others. For this project, an extract was used to investigate antibacterial activity of *R. michauxii* against *Staphylococcus aureus* and *Escherichia coli*. The extract was made by grinding leaf material with a mortar and pestle, dissolving the resulting powder in ethanol, and after a period of 72 hours. Then separating the ethanol from the extract using a rotary evaporator. The concentrate was collected with deionized water, flash frozen to -80°C, desiccated in a DNA concentrator, then mixed with DMSO at concentrations of 1mg/mL and 3mg/mL. These concentrations of the extract were added to LB broth with the bacteria cultures. The *E. coli* showed resistance to the extract at both tested concentrations. The *S. aureus* showed significant concentration reduction in log number. Future research involves additional bioassays, disc diffusion extract susceptibility testing, and secondary compound identification.

BBB 35 - Effect of Microhabitat Variation on Spring Ephemeral Plant Diversity

Collin Durant

Reinhardt University, Waleska, GA

Cherokee County lies at the intersection of the Blue Ridge, Peidmont, and Ridge and Valley ecoregions. Many of the implications of this have not yet been studied, including those that affect the biology and ecology of ephemeral plants. The intent of the present study is to gather preliminary data in multiple areas of the ecology of spring ephemeral plants. The study is being conducted on privately-owned land under a conservation easement in Cherokee County, GA. Four 20 m x 20 m plots were established in the following habitat types – a dry upland slope, a mesic streamside slope, a wet seepage area and a disturbed site with a high density of invasive species. Soil samples were collected from each site and analyzed for soil texture, soil moisture, pH and content of Nitrogen, Phosphorus and Potassium. Plots were then randomly sampled to estimate population size of various species of spring ephemerals. Richness and diversity of spring ephemerals will be calculated for each plot and compared. We hope to eventually use the results of this study to address the following

questions: Firstly, how does position along a slope affect the ecology of ephemeral plants? Secondly, does soil composition affect the time and location of ephemeral appearances and blooms? Thirdly, is there an interspecies effect with the ephemeral plants and other ephemeral plants and/or the canopy trees? Lastly, what are the implications this study has on the various land management strategies that may occur on this property?

BBB 36 - The Effects of Urbanization on the Biological Integrity of Georgia Streams

Schuyler Gentry

Reinhardt University, Waleska, GA

Rapid Biological Assessment using macroinvertebrates is currently one of the most popular and widely used metrics in determining the health of a stream. Although freshwater is a small fraction of the water on earth, it contains a vast amount of biodiversity. For this reason, it is important to monitor the health of streams and the impact we, as humans, are having on our own resources. To determine this effect, I asked the question; what is the stream health of Moore's Mill Creek compared to Shoal Creek. These are two creeks in very different habitats, but both located in Waleska, Georgia, which makes them perfect to test the effects of urbanization. Data was collected and analyzed according to the Georgia Adopt-A-Stream monitoring manual and data sheet. Data for both creeks was collected by seining in riffle areas and gathering handfuls of leaf litter in the same quantities. Following collection, samples were taken to the lab to be observed and identified using the aquatic macroinvertebrates field guide for Georgia streams. Lab results were used to give a stream health score depending on presence of specific taxa at each site. Moore's Mill Creek received a score of 11 (fair), while Shoal Creek was given a score of 26 (excellent). Urbanized land is known to decrease macroinvertebrate abundance and diversity, therefore, insinuating a decrease to stream health. This is seen at Moore's Mill Creek where the immediate area is much more developed than that of Shoal Creek. Considering these findings, it is plausible to say that Moore's Mill Creek is unhealthy compared to Shoal Creek. At this point it would be best to consider possible restorative actions to increase the health of Moore's Mill Creek. Restorative avenues include increasing habitat heterogeneity and monitoring the input of pollution into the stream by urbanized landscapes.

BBB 37 - Chemoreception in the fall armyworm, Spodoptera frugiperda: New strategies for management

Michele Moncrief, Corey Brooke, Leah Pool, Hannah Rose, Jordan Sparks, Joanna Gress

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The fall armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae), is one of the most detrimental pests of corn and grasses in the Southeastern United States. This pest causes economic losses exceeding $160 million per year. Despite consistent losses resulting from the fall armyworm, many growers are reluctant to use current integrated pest management (IPM) methods for this insect. This can stem from several factors including; heavy infestations are unpredictable, scouting multiple times each summer takes time and skill, and insecticides are expensive and raise health or environmental concerns. Research towards integrated pest management strategies based on chemoreception has proved promising. Chemoreception is the way an insect perceives its environment and mediates many important pest behaviors including: host plant, mate and oviposition site location. To study the chemoreception response to toxins in the fall armyworms' diet, we conducted a qPCR analysis of *S. frugiperda* caterpillars feeding on an artificial diet. In this study, larvae were fed a diet laced with nicotine and a diet laced with niacin to compare the expression of 18 olfactory- and gustatory-related genes. Nicotine, is a potent neurotoxin and has been utilized in numerous insecticides as a natural combatant to herbivory, whereas niacin is a chemical analog of nicotine found naturally in corn. These results will potentially advance the molecular knowledge of fall armyworm chemoreception and identify candidate genes that may serve as molecular targets for IPM

BBB 38 - Effects of Tetracycline Exposure on Rotifer (Philodina acuticornis) Egg Production in the Parental and F1 Generation

AnnaTaylor Hydrick

Erskine College, Due West, SC

Antibiotic run-off has become a problem because antibiotics such as tetracycline can affect the aquatic environments into which they are released. One group of organism affected by this contamination are rotifers, eukaryotic aquatic invertebrates, which serve as a crucial link in the food chain of most ponds, lakes, rivers and even ocean systems. In this study, rotifers (*Philodina acuticornis*) were exposed to different levels of tetracycline within environmental levels (0.025 mg/L to 25 mg/L) for a period of two weeks to test the effects of the antibiotics on their reproduction. During the second phase of the study, the reproduction of F1 generation of rotifers whose parents were exposed to tetracycline was studied. Higher levels of tetracycline (25 mg/L and 2.5 mg/L) stunted rotifer egg production in both the parents and F1 generations, but lower levels of tetracycline either increased egg production from normal levels or had no effect. Rotifers serve as a model organism for ecotoxicity, and the results of this study demonstrate the effects tetracycline and antibiotics could be having on other organisms in aquatic systems.

BBB 39 - Does Stream Health Affect Parasites Load in Lepomis Species?

Jonathan Carpenter

Reinhardt University, Woodstock, GA

I explored the possibilities of using parasites as biological indicators when comparing stream health. I studied Moore's Mill and Shoal Creeks in Cherokee County, Georgia. I hypothesized that as Moore's Mill Creek passes through the middle of Reinhardt Campus, it would have the most human interaction and thus, will have a higher *Posthodiplostomum minimum* infection among fish as the pollutants increase. I then collected Centrarchid host specimens and preserved them in the freezer until dissection. Centrarchids were chosen as they had a smaller digestive system and they share a common, easily identified parasite *P. minimum*. Fish were measured to total length and standard length (cm) and weighed (g), and then dissected and sexed. Viscera including the heart, spleen, liver, kidney, intestines, and stomach were placed in petri dishes and observed separately. A bodywash was done and observed to search for any parasite that may have been dislodged in the dissection process. Parasites were recorded based on location and quantity. *P. minimum* was the most common parasite species identified, while other parasites were identified to the lowest taxonomic level possible. Seven fish collected from Moore's Mill Creek contained a total of 168 parasites, while five fish collected from Shoal creek contained a total of 66 parasites. Forty-seven of the 168 parasites from Moore Creek were identified as *P. minimum* while 57 of the 66 parasites found in Shoal Creek were *P. minimum*. The average number of *P. minimum* per fish in Moore's Mill Creek (1.88 ± 2.4), did not differ from the same measure in Shoal Creek (3.56 ± 4.18; two-tailed T-test $P = 0.11$) thereby indicating a lack of support for my initial hypothesis.

BBB 40 - A survey of madtom catfish population density at sites with differing mussel shell density

Cole Clark

Western Kentucky University, Bowling Green, KY

A prior study conducted by a student at WKU showed evidence of madtom catfish in the Green River preferentially using shells of deceased mussels as cover. I hypothesized that there would be more madtoms at sites with higher mussel shell availability. To test my hypothesis, I performed daytime snorkel surveys to assess the density of mussel shells and madtoms. I surveyed five sites along the Green River in Kentucky. Included in these sites are two sites in Greensburg KY, one site in Munfordville KY, and two sites in Horse Cave KY. At each site, I performed three 15-m snorkel surveys in riffle habitat (< 0.7 m depth). There was a negative relationship between the number of available shells and the density of madtoms. Greensburg, the area with the highest density of madtoms, had the lowest density of dead mussel shells. Further research will be conducted to increase the number of sites and to collect information on other environmental variables that are affecting madtom density.

BBB 41 - Sampling the 'Wild': Isolation of Yeast Strains from Rowan County, North Carolina

Kara Cline

Catawba College, Salisbury, NC

The novelty of isolating wild yeast for natural fermentation of malt extract has grown in concert with the expansion of the microbrew industry. In collaboration with New Sarum Brewery in Salisbury, North Carolina, we sought to isolate and characterize yeast strains obtained from the 'wild' environment of Rowan County. To begin our environmental exploration, we cultured samples that included acorns, maple tree sap, and malt grain in yeast potato dextrose (YPD) broth. Cultures were allowed to grow for 6-7 days in a 25 °C fermentation cabinet. After 7 days active fermentation was observed in culture tubes. Mixed culture broth from each sample type were plated and allowed to grow for 48-72 hours. Colonies that exhibited yeast-like morphology were examined under the microscope to confirm presence of yeast cells (as opposed to bacteria). Following positive confirmation, a single colony was sub-cultured twice to ensure isolation of single yeast strains. Although all of the sample types tested resulted in fermentation, the Willow Oak acorn sample produced yeast of the same morphology consistently. With this result, we inquired as to whether the yeast would be found on the pericarp, the cotyledon, or both. To test this, acorns were separated into these two fractions, and cultured in YPD broth along with samples that were prepared containing both as a control. We found that yeast colonies were produced consistently in all fractions regardless of sample type. Axenic yeast isolates of wild origin will be tested for malt fermentation capacity, flavor profile, and genetically identified using a standard ITS1-5.8S rDNA-ITS2 assay as described (Masoud et al., 2004).

BBB 42 - Effects of Tricaine and Propofol on Sensory Function in Elasmobranchs

Molly Lanier

Georgia Southern University, Statesboro, GA

Sensory function in elasmobranchs is a widely studied topic, however, studies on how anesthesia impacts sensory function in elasmobranchs are not as common. Tricaine, a common anesthesia used in physiological treatments, is believed to affect sensory function, but there is very limited evidence that supports this claim concerning elasmobranchs. Similarly, studies on Propofol, another type of anesthesia used in aquariums, do not have significant evidence to determine the effect on sensory function. Our objectives are: to determine the effects of Tricaine and Propofol on *Urobatis halleri* (Round Stingray) by testing sensory criteria under six different dosages. For this research experiment, we had 12 different treatments: 6 dosage treatments for 2 anesthesia ranges. The rays were immersed in one of the treatments while every two minutes we tested escape response, righting reflex, and a fin pinch. Each of these reaction responses tested allowed us to make a dose-response curve showing the desired concentration of both anesthesia on the rays. We found that the desired concentration for Propofol was 0.5 mg/L and 62.5 mg/L for Tricaine. These desired concentrations have the lowest induction and recovery times therefore providing less stress to the animals. We also found that Propofol has a longer active time for the Round Stingrays than Tricaine possibly due to Propofol being metabolized slower because of its function of maintaining a surgical plane of anesthesia.

BBB 43 - Effect of abiotic factors on the condensed tannin concentration in Chamaecrista fasciculata

Andrew Disco

Mars Hill University, Mars Hill, NC

Chamaecrista fasciculata (partridge pea), like many plants, possess several defense mechanisms to protect against herbivory. *Chamaecrista fasciculata* produces nectar glands at the base of the leaves called extrafloral nectaries (EFNs) that are used as an indirect defense, attracting ants that drive away potential herbivores. *Chamaecrista fasciculata* also produces a direct chemical defense in their leaves and flowers called condensed tannins. Condensed tannins bind proteins while herbivores chew and prevent the digestion of proteins, resulting in malnutrition or even death of the herbivore. While EFNs are highly effective defenses, they only work in the presence of ants. Condensed tannins are effective regardless of ant populations. The production of plant defenses is energetically expensive. Limited resources present the potential for tradeoffs between defense strategies or in what plant tissue is defended. This study tests how differences in resource availability (nutrients and water) affect defense strategies in *C. fasciculata*. In this fully-factorial design, *C. fasciculata* plants grown in the Mars Hill University greenhouse were exposed to one of four treatments: fertilizer and high water, fertilizer and low water, no fertilizer and high water, or no fertilizer and low water. Once the plants grew to maturity, samples of flowers and leaves were taken from each plant and condensed tannins were chemically extracted to look for tradeoffs in defending flowers vs. leaves;

this data collection is still in progress. The results of this study will then be compared to previously collected data on EFNs of these same plants to determine how abiotic factors influences tradeoffs in direct vs. indirect defenses.

BBB 44 - Invertebrate pollinator use of suburban greenspaces in Whitfield County, Dalton, Georgia

Brittany Jensen, Jared Burns, David DesRochers

Dalton State College, Dalton, GA

Within the last decade there has been a growing decline of invertebrate pollinators due to a variety of mechanisms such as exposure to pesticides, fragmentation and loss of habitat, and disease. These have resulted in a growing need to develop conservation efforts to support declining invertebrates. Our study focused on attracting invertebrate pollinators to Lakeshore and James E. Brown Parks in Dalton, Georgia, USA, between 20 March-10 September 2018. With 6 species of pre-planted clover, we were able to attract, observe, and collect invertebrate pollinators as well as gather flowering phenology data. We collected 182 individual pollinator specimens representing seven genera between 15 May-6 September. We also recorded 57,358 entries of flower data that elucidate clover flowering phenology in suburban green spaces. *Trifolium vesiculosum Savi.*(Apache Arrowleaf) had the lowest range of 1-24 blooms and *Trifolium resupinatum* (Persian) had the highest range of 19-1314 blooms between 15 May-27 June. Observations of pollinator activities also reinforced the value of several of the clover species, as some of the clover species did not emerge. Importantly, the data collected can help contribute to further conservation of invertebrate species, particularly in urban greenspaces, such as residential parks.

Beta Beta Beta Award Winners

District I Brooks Awards for Excellence in Oral Presentation: 1st Deanna Doughty, 2nd Andrew Mixson, 3rd Katherine Barrs

1st: "Optimizing Primary Microglia Isolation and Culture," **Deanna Doughty**, Augusta University, Augusta, GA

2nd: "Investigation of the toxicological effects of CNT-Ab in mice following microwave hyperthermia," **Andrew Mixson**, Moses Kusi, Amy Chall, John Stagg, Wilmot Gissendanner, Austin Rawlings and Mernyse Bruce, Georgia Southern University, Statesboro, GA

3rd: "Predicting Colony Recognition in Argentine Ants," *Linepithema humile*, **Katherine Barrs**, Georgia Southern University, Statesboro, GA

District II Brooks Awards for Excellence in Oral Presentation: 1st Erin Clayton, 2nd Jonathan Kilroy, 3rd Stephen Won (not pictured), HM Karen Inouye (not pictured)

1st: "Pancreatic beta cell dysfunction in response to chronic hyperglycemia is partially mediated by transcriptional downregulation of Gli-similar 3 (Glis3)," **Erin Clayton**, Beta Pi chapter, Hardin, KY

2nd: "Conversion of Glycerol to Butanol Using a Continuous Culture of *Clostridium pasteurianum*," **Jonathan Kilroy**, University of Alabama at Huntsville, Huntsville, AL

3rd: "The Impact of Heavy Metal Pollution from Small-Scale Golding Mining on Microbial Communities," **Stephen Won**, Birmingham-Southern College, Birmingham, AL

HM: "First Evidence of Striped Bass Natural Reproduction in the Tennessee River," **Karen Inouye**, Samford University, Birmingham, AL

District I Johnson Awards for Excellence in Poster Presentation: 1st Chase Robinson, 2nd Mary Oliver (not picture), 3rd Francisco Garcia, HM Kara Cline (not pictured)

1st: "The Sucking Louse Fauna of Mongolian Rodents: Host Associations, Molecular Phylogenetics and Description of a New Species," **Chase Robinson**, Georgia Southern University, Statesboro, GA

2nd: "The Effect of Micro-RNA 200a Targeting PTEN to Inhibit Apoptosis in THP-1 Cells Following a Lipopolysaccharide-Induced Immune Response," **Mary Oliver**, Mary Baldwin University, Stauton, VA

3rd: "Susceptibility of Microorganisms to *Rhus michauxii* Extract," **Francisco Garcia**, Abraham Baldwin Agricultural College, Tifton, GA

HM: "Sampling the 'Wild': Isolation of Yeast Strains from Rowan County, North Carolina," **Kara Cline**, Catawba College, Salisbury, NC

District II Johnson Awards for Excellence in Poster Presentation: 1st Sharee Riggs, 2nd Mariah Slaughter (not pictured), 3rd Jesse Hunt

1st: "Food for the Future: A Study of Insects as a Protein Source for Global Food Security," **Sharee Riggs**, University of Alabama in Huntsville, Huntsville, AL

2nd: "Determination of Madtom Shelter Preference," **Mariah Slaughter**, Western Kentucky University, Bowling Green, KY

3rd: "Effect of steroid hormone treatment on the viability of a glial cell line," **Jesse Hunt**, Tracee Guthrie and Candice Tate, Columbus State University, Columbus, GA

2019 Chapter of the Year: Georgia Southern University, Tau Kappa, District I

2019 Chapter of the Year: Troy University, Mu Epsilon, District II

2020 District I Officers: President Claire Fabian-Bayola, Vice President Andrew Mixson, Secretary Katherine Barrs

2020 District II Officers: President Emily Anderson, Vice President Meet Patel, Secretary Abigail Nienaber

Advisors of the Year: Steve Coggin, Catawba College, Lisa Ann Blankinship, University of North Alabama

ASB Special Events

Seminars

NSF Seminar

Roland Roberts and Andrea Weeks

Come learn about National Science Foundation programs and areas of funding supported by the Directorate for Biological Sciences. Information on current and new funding opportunities and changes in programs (e.g., no deadlines) will be discussed. The second half will be a question and answer session followed by opportunities to interact with individual program directors. This session will be focused on opportunities available for faculty and other professionals, although early career individuals are encouraged to attend. Another session will be focused on opportunities for undergraduates, graduate students, and postdocs.

NSF Seminar

Andrea Weeks and Roland Roberts

National Science Foundation information session for early career individuals

Come learn about the basics of the National Science Foundation as well as opportunities for undergraduate students, graduate students and postdoctoral researchers that are supported by the Directorate for Biological Sciences. The session will cover how NSF funds research, the grant proposal process, as well as details about Research Experiences for Undergraduates (REU) opportunities, the Graduate Research Fellowship Program (GRFP), and the Postdoctoral Research Fellowships in Biology (PRFB). A question and answer session will follow the overview of the training opportunities and tips on proposal preparation.

Workshops

Timing is Everything! Using Phenology to Track Climate Shifts in Classroom and Research Laboratories

Jennifer Rhode Ward[1], Alisa Hove[2], Howard Neufeld[3] and Amy Boyd[2], [1]University of North Carolina Asheville, Asheville, NC[2]Warren Wilson College, Asheville, NC[3]Appalachian State University, Boone, NC

Phenology, the timing of life history events, is straightforward for undergraduates, graduate students, and citizen scientists to track, and the data garnered by such monitoring can yield important insights into the effects of both interannual variability and long-term climate shifts. In this workshop, participants will receive example lab modules for teaching plant phenology in undergraduate laboratories, will explore examples of phenology trails on two campuses, will receive guidelines for creating their own trails, and will explore the National Phenological Network and Nature's Notebook phenological data portal. Tools and materials given to participants were developed by faculty from liberal arts and masters'-granting institutions as part of a National Science Foundation grant assessing plant ecological responses to global change in the Southern Appalachians.

Life Science Lab Speed Dating with Bio-Rad!

Leigh Brown, Bio-Rad Laboratories, Hercules, CA and Tamica Stubbs, Bio-Rad Laboratories, Charlotte, NC

In this session, participants will be presented with an opportunity to engage in one to three lab experiences designed to equip their students of their introductory biology courses with fundamental content, content connects and essential scientific lab skills to improve interest and success in class. Proficiencies will include qualitative & quantitative mushroom enzyme assays (for biofuel production), photosynthesis and cellular respiration colorimetric assays with algae beads, and the genetics, statistical analysis and bioethics of opioid addiction DNA lab. Participants will have the freedom to select, peruse or actively explore desired stations throughout the session.

Field Trips

Field Trip: Wolf River Canoe Tour

Sponsored by the University of Tennessee at Martin, Department of Biological Sciences and the Reelfoot Lake Environmental Field Station.

Enjoy a scenic natural history canoe trip on one of the few remaining unchannelized rivers in West Tennessee with ecologists from UT Martin. This six mile section of the Wolf River winds through the Lost Swamp Trail which features habitats characteristic of the West Tennessee Mississippi River Flood Plain including old growth cypress forest, flooded bottomland hardwood forest, and open areas of spatterdock. Along some stretches canoes must go single file and make sharp turns around trees. We will leave from the conference hotel at 8am and return at approximately 3pm (roughly 4 hrs. on the river). Canoes are provided, but please bring water and lunch/snacks with you on this field trip.

Meet in the Sheraton Lobby. Transportation by carpooling/caravanning.

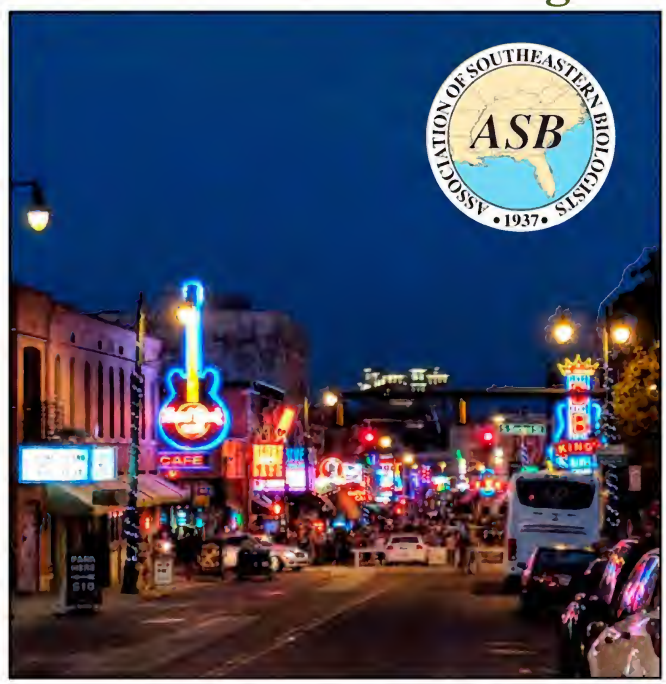
Field Trip: Old Growth Forest and Spring Flora in Overton Park

Sponsored by the Southern Appalachian Botanical Society.

Southern Appalachian Botanical Society Field Trip trip to see the early spring flora and old growth trees in Overton Park State Natural Area located in Memphis. Trip will include lunch provided by SABS. Carpool to the site from the Convention Center.

Meet in the Sheraton Lobby. Transportation by carpooling/caravanning.

Association of Southeastern Biologists
80th Annual Meeting



THE UNIVERSITY OF MEMPHIS

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Southern Appalachian Botanical Society

SE SECTION

NABT

esa SE CHAPTER

Society of Herbarium Curators SE CHAPTER

TRIBETA DISTRICTS I & II

Sheraton Memphis Downtown Hotel

3-6 APRIL 2019

Celebrating over 80 Years of Science in the Southeast!

Association of Southeastern Biologists 2019

Meeting-At-A-Glance

Wednesday, April 3 – April 5, 2019
Memphis Cook Convention Center and
Sheraton Memphis Downtown Hotel

Wednesday, April 3rd

Time	Event	Location
8:00 AM – 5:00 AM	ASB Logistics Room	St Louis
9:00 AM – 4:00 PM	Exhibitor Set-up	Exhibit Hall SW
11:00 AM – 9:00 PM	Registration Open	Exhibit Hall SW
11:00 AM – 2:00 PM	Exhibitor's Break (exhibitors only)	Exhibit Hall SW
1:00 PM – 6:00 PM	ASB Executive Committee Meeting	Sheraton -Nashville
1:00 PM – 6:00 PM	SABS Executive Council Meeting	Sheraton – Heritage 1
6:30 PM –8:00 PM	Welcome and R.H. Martin Plenary Address Neil Shubin with *Your Inner Fish*	Ballroom A
8:00 PM – 9:30 PM	Welcome Receptions	Exhibit Hall SW

Thursday, April 4th

Time	Event	Location
7:00 AM – 5:00 PM	Registration Open	Exhibit Hall SW
7:00 AM – 5:00 PM	PowerPoint Preview Check ASB Logistics Room	Build out in Hall Build out in Hall – Sheraton – St Louis
7:00 AM – 8:15 AM	ASB Past President's Breakfast Meeting	Sheraton - Heritage 1
8:00 AM – 5:00 PM	ASB POSTER SESSIONS – AM / PM	Exhibit Hall SW
8:00 AM – 5:00 PM	Exhibits Open	Exhibit Hall SW
10:00 AM – 11:00 PM	Workshop: Timing is Everything! Using Phenology to Track Climate Shifts in Classroom and Research Laboratories	Sheraton - Heritage 1

8:00 AM – 5:00 PM	ASB Paper Presentations	BR C BR D BR E Mtg Rm 203/204 Mtg Rm 201/202 Mtg Rm 205 Ballroom B
11:30 AM – 1:15 PM	Lunch ASB Diversity Committee and SE Chapter of Ecological Society of America Joint Luncheon SHC SE Chapter Luncheon/Business Meeting	Sheraton and local venues Sheraton - Heritage 1 Sheraton - Heritage 2
2:30 PM – 3:30 PM	NSF info session	Mtg Room 205
5:00 PM – 6:00 PM	SABS/BSA Student Reception	Second Level Patio / Heritage Foyer for Backup
5:00 PM – 6:00 PM	ASB Business Meeting (*All ASB members invited)*	Ballroom C
6:00 PM—10:00 PM	Thursday Night ASB Social Blues City Café Street Party	Blues City Café 138 Beale St, Memphis TN 38103 Transportation provided on rotating continuous basis from 5:45pm to 10:30pm. Must have badge and ID to enter venue.

Friday, April 5th

Time	Event	Location
7:00 AM – 12:00 PM	Registration Open	Exhibit Hall SW
7:00 AM – 8:15 AM	SABS/BSA Breakfast Meeting	Sheraton - Heritage 1
7:00 AM – 5:00 PM	PowerPoint Preview Check ASB Logistics Room	Build out in Hall Build out in Hall – Sheraton – St Louis
8:00 AM – 5:00 PM	ASB POSTER SESSIONS – AM / PM	Exhibit Hall SW
8:00 AM – 6:00 PM	β β β Officers & Judges Room	Sheraton - Heritage 4
9:00 AM – 12:00 AM	β β β Poster session	Exhibit Hall SW
9:00 AM – 10:00 AM	β β β Joint Business Meeting (all delegates MUST attend)	Sheraton - Magnolia
10:00 AM – 11:00 AM	Workshop: Life Science Lab Speed Dating with Bio-Rad!	Sheraton - Heritage 1

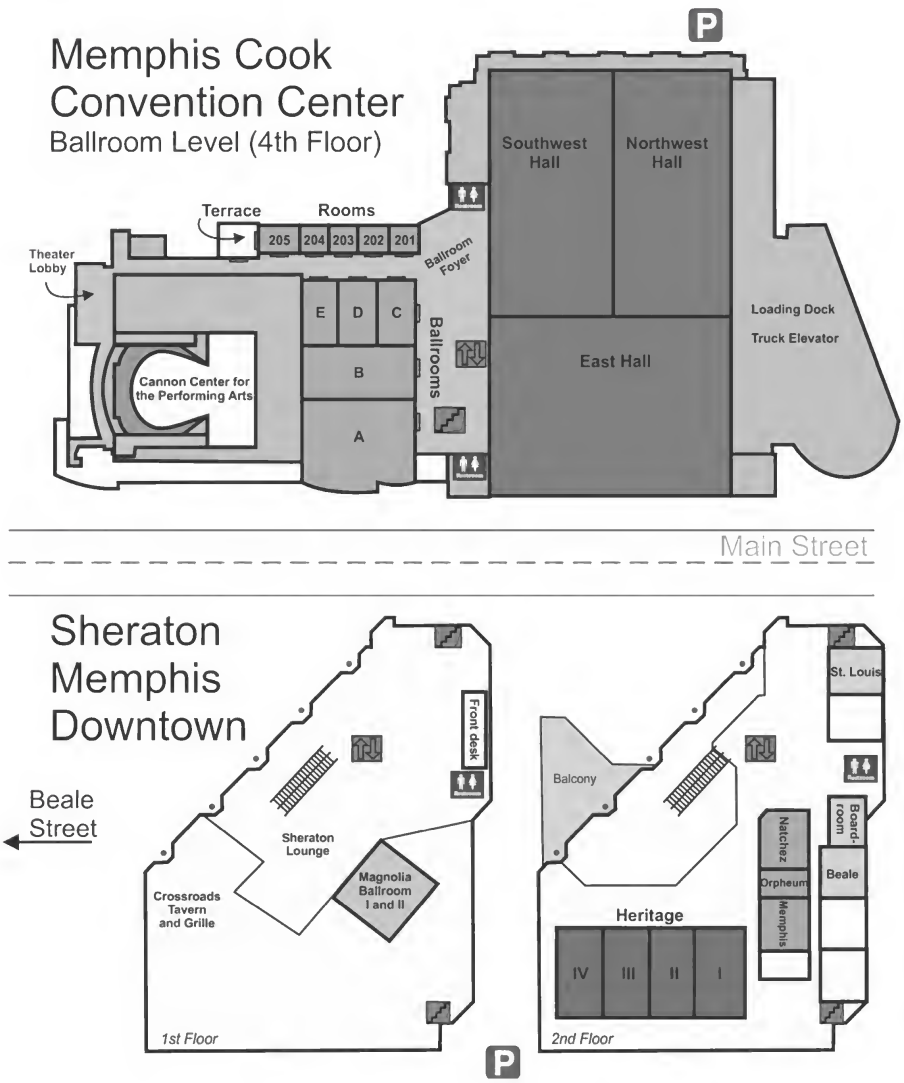
8:00 AM – 5:00 PM	ASB Paper Presentations	BR C BR D BR E Mtg Rm 203/204 Mtg Rm 201/202 Mtg Rm 205 Ballroom B
11:30 AM – 1:15 PM	Lunch Education Committee's '*Lunch and Learn*'	Sheraton and local venues Sheraton - Heritage 1
1:00 PM – 5:00 PM	β β β Paper Presentations District I — District II —	Sheraton Magnolia Heritage 3
2:30 PM – 3:30 PM	NSF info session	Mtg Room 205
5:00 PM – 6:00 PM	β β β Joint Session and Awards	Sheraton - Magnolia
6:30 PM – 9:00 PM	ASB Awards Banquet	Ballroom A

Saturday, April 6th

Time	Event	Location
7:00 AM- 2:00 PM	**ASB Logistics Room**	Sheraton – St. Louis
7:30 AM – 8:30 AM	**ASB Executive Committee Breakfast**	Sheraton - Nashville
8:30 AM – NOON	**ASB Executive Committee Meeting**	Sheraton - Nashville
8:00 AM – 3:00 PM	**Field trip:** Wolf River Canoe Tour sponsored by the University of Tennessee at Martin, Department of Biological Sciences and the Reelfoot Lake Environmental Field Station	Sheraton lobby Transportation by carpooling/caravanning
9:00 AM – 1:00 PM	**Field trip:** Old Growth Forest and Spring Flora in Overton Park sponsored by the Southern Appalachian Botanical Society	Sheraton lobby Transportation by carpooling/caravanning

Restrooms
Elevator
Stairs

Association of Southeastern Biologists
Annual Meeting, Memphis, TN 2019



FEATURED INSTITUTIONS

University of Memphis

University of Tennessee Martin

EXHIBITORS

Associated Microscope

Beta Beta Beta

Bio-Rad Laboratories

Capital Microscope Services

Columbus State University

Eastern Kentucky University

James Madison University

Kennesaw State University

Martin Microscope

Medical Incorporated

National Association of Biology Teachers

NatureCITE

PhbeaD

PhotoGofer

Samford University

Southern Appalachian Botanical Society

University of Alabama Press

University of Louisiana Monroe Biology Graduate Program

University of Mississippi Department of Biology

University of Southern Mississippi Graduate School

Wiki Education

R. H. Martin Plenary Address

Wednesday 6:30 PM - 8:00 PM Ballroom A	**R. H. Martin Plenary Address** Neil Shubin	**Your Inner Fish** In this lecture, Neil Shubin tells the story of our bodies as you've never heard it before. By examining fossils and DNA, he shows us that our hands actually resemble fish fins, our heads are organized like long-extinct jawless fish, and major parts of our genomes look and function like those of worms and bacteria. Tailoring his remarks to scientific or lay audiences, Shubin makes us look at ourselves and our world in an illuminating new light. *Books will be available for purchase and signing after the plenary.*

Workshops and Seminars

Thursday 10:00 AM - 11:00 AM Heritage I	**Workshop** Jennifer Rhode Ward, Alisa Hove, Howard Neufeld, Amy Boyd, Warren Wilson	**Timing is Everything! Using Phenology to Track Climate Shifts in Classroom and Research Laboratories** Phenology, the timing of life history events, is straightforward for undergraduates, graduate students, and citizen scientists to track, and the data garnered by such monitoring can yield important insights into the effects of both interannual variability and long-term climate shifts. In this workshop, participants will receive example lab modules for teaching plant phenology in undergraduate laboratories, will explore examples of phenology trails on two campuses, will receive guidelines for creating their own trails, and will explore the National Phenological Network and Nature's Notebook phenological data portal. Tools and materials given to participants were developed by faculty from liberal arts and masters'-granting institutions as part of a National Science Foundation grant assessing plant ecological responses to global change in the Southern Appalachians.
Friday 10:00 AM - 11:00 AM Heritage I	**Workshop** Leigh Brown, Tamica Stubbs	**Life Science Lab Speed Dating with Bio-Rad!** In this session, participants will be presented with an opportunity to engage in one to three lab experiences designed to equip their students of their introductory biology courses with fundamental content, content connects and essential scientific lab skills to improve interest and success in class. Proficiencies will include qualitative & quantitative mushroom enzyme assays (for biofuel production), photosynthesis and cellular respiration colorimetric assays with algae beads, and the genetics, statistical analysis and bioethics of opioid addiction DNA lab. Participants will have the freedom to select, peruse or actively explore desired stations throughout the session.

Thursday 2:30 PM - 3:30 PM Mtg Rm 205	**NSF Seminar** Roland Roberts, Andrea Weeks	**National Science Foundation information session for faculty and other professionals** Come learn about National Science Foundation programs and areas of funding supported by the Directorate for Biological Sciences. Information on current and new funding opportunities and changes in programs (e.g., no deadlines) will be discussed. The second half will be a question and answer session followed by opportunities to interact with individual program directors. This session will be focused on opportunities available for faculty and other professionals, although early career individuals are encouraged to attend. Another session will be focused on opportunities for undergraduates, graduate students, and postdocs.
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Thursday, April 4, 2019 AM

Symposium: The Zebrafish Symposium Mtg Rm 205	
8:00 AM	46 – Characterizing gene regulation of the Meis2 locus **Ted Zerucha**
8:15 AM	47 – The Behavioral Effects of Delta-9-Tetrahydrocannabinol (THC) on a Spastic Mutant **Victoria Mendiola**
8:30 AM	48 – Toxicity and localization of Virus Like Particle HK97 in Danio rerio **Bridget Fitzgerald**, Olivia Brandenburg, Baylie Catrett, Michael King, Dustin Patterson and Brent Bill
8:45 AM	49 – Zebrafish, Standard Operating Procedures, and Bioinformatics: Educational and Marketable Exercises for Students Enrolled in Upper-Level Undergraduate Courses **Adam Davis**
9:00 AM	50 – Neurotrophic receptor tyrosine kinase expression in embryonic zebrafish **Katie Hahn** and Cortney Bouldin

	Community Ecology A **BR B**	**Plant Collections and Herbaria** **BR C**	**Invertebrate Biology A** **BR D**	**Ecosystem and Landscape Ecology** **BR E**	**Microbiology A** **Mtg Rm 201/202**	**Scholarship of Teaching and Learning A** **Mtg Rm 203/204**
8:00 AM	1 – Dendroecology of Carolina hemlock (Tsuga carolinana Engelm.) stands in the southern Appalachian Mountains **Marcus Wind**, Laura DeWald, Tara Keyser and Beverly Collins	8 – Contributions from the University of South Florida to the flora and mycoflora of the southeastern USA **Arian Farid** and Alan Franck	16 – Investigation of Thermal Heterogeneity as a Driver of Thermoregulation and Plasticity using the Differential Grasshopper (Melanoplus differentialis) **Devin Preston**	24 – The long-term effect of different reforestation strategies on forest composition on Block Island, Rhode Island **Christopher Coggin** and Heather Griscom	31 – Characterization of Novel Clostridium difficile Virulence Targets: A Structural Biology Approach **Isria Jarrett**, Darlene Panvini, Heather Kroh and Borden Lacy	39 – Building student research experience within a multi-decade study of mercury presence in terrestrial ecosystems of the Shenandoah Valley, VA. **Dean Cocking**
8:15 AM	2 – Survey of rare plants within a calcareous flatwoods community and analysis of plant-environmental relationships **John Patten Moss**, Natalie Bailey, William Walker and Martin Cipollini	9 – The Effect of Rising Sea Level on Coastal Vegetation in South Carolina **Richard Stalter**	17 – Reproductive life history and shell shape variation of three species of Elimia (Pleuroceridae) in the Lower Etowah River Basin. **Ellen Winant** and Bill Ensign	25 – Community structure and species composition across an elevation gradient within a floodplain forest of the Congaree River, South Carolina, USA **William Conner**, Gavin Blosser, Alex Chow, Bo Song, William Bridges and Graeme Lockaby	32 – Combating drug resistance - Comparison of the antibiotic effect of Hydrastis canadensis extract and pure Berberine via Minimum Inhibitory Concentration assay **Luke Scott** and Timothy Trott	40 – Trees that Teach: Doing Science with 277 Students in Introduction to Environmental Science **Stephanie Jeffries**
8:30 AM	3 – Use of DNA Barcoding as an Effective Tool in Earthworm Identification and Diversity Analysis in Native and Exotic Plant Plots **Bailee Powell**, Erin Laubacher, Chris Barton and Darlene Panvini	10 – Ready, Set, Go: The Southeastern Grasslands Initiative Launches Ecosystem-Specific iNaturalist Projects in 2019 to Gamify Biodiversity Documentation from the Southern Grassland Biome **Dwayne Estes**, Theo Witsell, Alan Weakley, Reed Noss and Cooper Breeden	18 – Redescription and Circumscription of the Acuminate Crayfish, Cambarus acuminatus Faxon, 1884 (Decapoda: Cambaridae) **Emmy Delekta**, Bronwyn Williams and Zachary Loughman	26 – Utilizing a remote sensing derived NDVI normal dataset and vegetation field data to assess post-fire effects and ecosystem recovery in the southern Appalachians **Diane Styers** and Peter Bates	33 – Examining the presence of antibiotic resistant Escherichia coli in Nashville, TN's Cumberland River. **Rachel Hongo** and Matthew Heard	41 – The revision of a core EEB course: experimenting with an interactive electronic textbook and a cloud based active learning platform to engage students **Heather Griscom**, Dana Moseley and Bruce Wiggins

8:45 AM	4 – Setting restoration and management goals for upland-embedded wetlands based on research of biological, geospatial, and hydrogeological data in the Daniel Boone National Forest, Kentucky **Stephen C. Richter**, Rachel Fedders, Kelly Watson, Jonathan Malzone, Matthew McClure and Luke Dodd	11 – A Reevaluation Of Tennessee's Non-Native Plant Species Using Online Herbarium Specimen Data To Develop Species Distribution Models **Courtney Alley** and Joey Shaw	19 – Examining the Antibiotic Effects of Hemolymph from Immune Challenged Squash Bugs (Anasa tristis) **Jacob Lemon** and Jeremy Blaschke	27 – Plant-arthropod associations of the "Botanical Lost World" **Joshua Fuller**, Tom Diggs and Evan Lampert	34 – Microbial Community Compositional and Functional Differences Observed Along Wetland Salinity Transects **Eric Weingarten** and Colin Jackson	42 – On Using the Freshman Biology Laboratory as an Undergraduate Research Experience **Maria Guerrero**
9:00 AM	Break for Posters	Break for Posters	Break for Posters	Break for Posters	Break for Posters	Break for Posters
10:30 AM	5 – Comparisons of plant communities at natural and constructed upland-embedded wetlands in the Daniel Boone National Forest, Kentucky **Rachel Fedders** and Stephen C. Richter	12 – Rescuing an imperiled collection: The integration of the Western Kentucky University Herbarium (WKU) into Austin Peay State University (APSC) **Mason Brock** and Dwayne Estes	20 – Divergence of Male Mating Preferences in Sympatric Calopteryx aequabilis and C. maculata Populations **Melissa Encinias** and Idelle Cooper	28 – Long-Term Effects of In-Stream Restoration on Biotic Assemblages in Sandy Bottom Streams in Fort Benning Military Installation, Ga **Daniel Isenberg**, Samuel Bickley, Jack Feminella, Natalie Griffiths and Brian Helms	35 – Detecting and Differentiating Pseudomonas species Within Soil, Water, and Plant Matter Following a Multiplex PCR Protocol **Courtney George** and Cynthia Ryder	43 – A New Natural History Collections Curriculum in Biological Sciences Education **Travis Marsico** and Kurt Neubig
10:45 AM	6 – Macro-ecological scale geographic variation of a keystone predator in a common garden environment **Kenzi Stemp**, Tom Anderson, Brittany Ousterhout and Jon Davenport	13 – Small herbaria significantly contribute unique biogeographic records to county-, locality-, and temporal-level scales **Travis Marsico**, Erica Krimmel, Richard Carter, Emily Gillespie, Phillip Lowe, Ross McCauley, Ashley B. Morris, Gil Nelson, Michelle Smith and Anna Monfils	21 – A Treasure Trove of Biodiversity Revealed in a Southern Illinois Pollinator Inventory **Nathan Soley**, Leila Kassim, Casey Bryan, Michael Arduser, Karla Gage and Sedonia Sipes	29 – An Ornamental Plant Found Spreading Aggressively: Potential Invasiveness of Dryopteris erythrosora (Dryopteridaceae) in North America **Hannah Umstead** and Tom Diggs	36 – Characterization of Vibrio vulnificus from Timucuan Preserve Water and Oysters **Janel Clarisse Palomo**	44 – Teaching with Wikipedia based Writing Assignments in the Organismal Biology Classroom **Jay Bolin**, Samantha Weald and Ian Ramjohn

11:00 AM	7 – Can cues about pitcher morphology explain differences in colonist abundance between Sarracenia purpurea and their hybrids? **Rebecca Hale**, Wayne Morgan, Caroline Kennedy and Jennifer Rhode Ward	14 – "Born digital," addressing the challenges of a field-to-database workflow for collections based research. **Caleb Powell**, Jacob Motley, Hong Qin and Joey Shaw	22 – Parasites and Plastics in Waterbirds Foraging Near Aquaculture Facilities in the Southeastern US **Kate Sheehan**, Katie Hanson Dorr, Brian Dorr, Stephen Clements, Terrel Christie and Brian Davis	30 – Chasing Nuttall: A Bicentenary Interpretation of Thomas Nuttall's Exploration of the Arkansas Territory **Theo Witsell**	37 – Biodegradation of a Common Herbicide, Metribuzin used in Louisiana **Thomas Phillips** and Ramaraj Boopathy	45 – An inquiry-based approach to science process using web-based watershed tools **Bill Ensign**
11:15 AM	Lunch	15 – Using Convolutional Neural Networks to Classify the Reproductive State of Digitized Herbarium Specimens **Dakila Ledesma**, Caleb Powell, William Baker, Joey Shaw, Yu Liang and Hong Qin	23 – Life History Notes on the Rare Ectoparasitiod Wasp Rhopalosoma nearcticum **Sarah Lounsbury** and Jeremy Blaschke	Lunch	38 – Comparison of Antibacterial Properties in Selected Plant parts of Spigelia marilandica **Sarah Crossan** and Darlene Panvini	Lunch

Thursday, April 4, 2019 PM

	Community Ecology B **BR B**	**Plant Floristics** **BR C**	**Animal Behavior** **BR D**	**Physiological Ecology** **BR E**	**Microbiology B** **Mtg Rm 201/202**	**Scholarship of Teaching and Learning B** **Mtg Rm 203/204**	**Genetics** **Mtg Rm 205**
1:15 PM	51 – Stability Analysis of a Relic Bottomland Hardwood Forest in Southwest Arkansas. **Joe Winstead**, Michael Held and Bart Emerson	55 – Using SERNEC Data to Plan your Next Family Road Trip **Joey Shaw**, Courtney Alley, Caleb Powell, Erica Rylander and John Shelton	63 – The paraventricular thalamic nucleus is necessary for melatonin-dependent seasonal changes in immunity and glucocorticoid secretion in Siberian hamsters **Elyan Shor** and David Freeman	71 – Natural tissue concentrations in adult Ambystoma maculatum and larval DNA damage from exposure to arsenic and chromium **Steven Gardner**, George Cline, Nixon Mwebi and James Rayburn	78 – Analysis of Thrombin- Treated GerE on Binding to cot Promoters that are Repressed during Sporulation in Bacillus subtilis **Alexandria Cedrone** and Dinene Crater	84 – An Examination of Undergraduate Students' Plant Blindness and Botanical Literacy **Kathryn Parsley**, Jaime Sabel, Laura Zangori and Jason Koontz	91 – Patterns of cytonuclear linkage disequilibrium between heteroplasmic and homoplasmic individuals of wild carrot, Daucus carota (Apiaceae), a gynodioecious plant species **Adam Ramsey**, David McCauley and Jennifer Mandel

1:30 PM	52 – Changes in Avian Diversity and Potential Invasive Seed Dispersal Post-Wildfire in an Eastern Deciduous Forest within the Flipper Bend Woods, Signal Mountain, Tennessee **Mary Feely** and David Aborn	56 – Vascular Flora and Habitat Assessment of Three Wetlands in the Red River Gorge Geological Area and Clifty Wilderness in Menifee and Powell counties of Kentucky **Calvin Andries** and Brad Ruhfel	64 – Scaring the silk out of spiders: The use of defensive silk in response to predatory and non-predatory stimuli in the western widow spider (Latrodectus hesperus). **Alphie Rotinsulu** and Aaron Corbit	72 – Maternal Effects in Response to Mycoplasma gallisepticum Infection in Eastern Bluebirds **Sarah Amonett** and Susan Balenger	79 – Investigating the Possible Correlation Between Microplastic Abundance and the Presence of Escherichia coli in the Cumberland River. **Chandler Phelps** and Matthew Heard	85 – LABS: A New Student Fellowship Program to Enhance Undergraduate Research Opportunities at Franciscan Missionaries of Our Lady University (Fran U) **Dawn Simms**	92 – Blazing New Paths to Investigate Blazing Stars: Development of Microsatellite Markers and Evaluation of Species Boundaries between Liatris helleri and Liatris turgida **Logan Clark** and Matt Estep
1:45 PM	53 – Plant species richness patterns are shaped by multiple ecological processes across space in the longleaf pine ecosystem **Kyle Palmquist** and Robert Peet	57 – Comparing the Georgia Endemic Calycanthus brockiana (Calycanthaceae) and Calycanthus floridus (Calycanthacea) using ITS and matK **Katie Horton**, Abby English, Tom Diggs and Clarke Miller	65 – The Efficacy of Bait-Trap Methods in Butterfly Monitoring in an Urban Park in Nashville, Tennessee **Marcie Bulla** and Darlene Panvini	73 – Nest microclimate influences physiology and development in the eastern bluebird (Sialia sialis) **Brooke Sykes** and Susan Balenger	80 – Isolation and Characterization of Exiguobacterium: An Antibiotic Producing Organism **Magnolia Valdez** and Eric Warrick	86 – Success and retention model for biology and computer science majors in Two-year colleges **Loretta Ovueraye**	93 – Investigations of the Forgotten Geum, Geum geniculatum Michx., Bent Avens **Marietta Shattelroe** and Matt C. Estep
2:00 PM	54 – Bee Diversity in Two High Quality Southern Illinois Limestone Glades **Jacob Chisausky**, Lillian McIntyre, Leila Kassim and Sedonia Sipes	58 – Tissue Culture and Plant Regeneration of the Endangered Schweinitz's sunflower (Helianthus schweinitzii Torr. & A. Gray) **Evelyn Abraham** and Kunsiri Grubbs	66 – Temperature effects on species interactions in green frog tadpoles **James Franklin** and Clifton Ruehl	74 – Response to rapid habitat perturbation in the slider turtle (Trachemys scripta): Behavioral and hormonal effects. **WB Cash**	81 – The Isolation and Identification of Antibiotic Producing Pseudomonas **Morgan Dettmer** and Eric Warrick	87 – Building Success in Course-embedded Undergraduate Research Experiences **Michael Renfroe**	94 – Distribution and Genetic Diversity of the Rare Plant Veratrum woodii (Liliales: Melanthiaceae) in Georgia **Rima Lucardi**, Wendy Zomlefer, Jason Comer, James Hamrick and James Allison
2:15 PM	Short Break	Short Break	Short Break	Short Break	Short Break	Short Break	Short Break

2:30 PM	Break for Posters - 3:45 PM	59 – The Lost Flora of Tennessee; A Floristic Investigation Into the Copper Hill Basin, Polk County, Tennessee. **John Shelton** and Joey Shaw	67 – Anthropogenic Sound in the Sea: Are Ascidians Affected? **Christa Edwards**, Kristine N. White and Louis J. Ambrosio	75 – The effects of field capture and laboratory management techniques on plasma corticosterone concentrations in the slider turtle (Trachemys scripta). **Alex Ano**, Lori Monday and WB Cash	82 – Identification of gram-positive bacterial species in expressed human breast milk: effects of re-refrigeration on safety for reuse **Cortni Troublefield**, Cynthia Ryder and Kathryn Gill	88 – Zero to Conference poster in 30 days: Conducting research within a one month class **Dane Kuppinger** and Laura Watts	Break for Posters - 3:45 PM
2:45 PM		60- County Records and Major Range Extensions for Angiosperms from the Lampasas Cut Plain of the West Cross Timbers and Prairies in San Saba and Mills Counties, Texas **Matthew Sheik**	68 - Factors Affecting Phonoresponse in Virgin Females of Syntomeida epilais (Lepidoptera: Erebidae, Arctiinae, Euchromina) **Francisco Coro**	76- Variation in Nickel Tolerance and Accumulation in Populations of Odontarrhena serpyllifolia (Brassicaceae: Alysseae) from the Iberian Peninsula **Joe Pollard**, Grace McCartha1 and Andrew Smith	83 - Antimicrobial Properties of Soil Microorganisms Underneath Exotic and Native Plant Species in Nashville, Tennessee **Britney Sams**, Adria Payne, Jennifer Thomas and Darlene Panvini,	89 Bluebirds in the House! A Project for Modeling Scientific Processes to Middle School Students **Annabelle McKie-Voerste**, Robert Price and Thomas Risch	
3:00 PM		61- Diamond in the rough: Rare and interesting plants recorded in Poinsett County, Arkansas Jennifer Reed and **Travis Marsico**	69 - The role of nitric oxide in memory formation of the dwarf cuttlefish, Sepia bandensis **Jessica Bowers,** John Wilson, Dragos Amarie and Vinoth Sittaramane	77 - Prey Size Variation Influences Fat Storage, Vitellogenesis, and Offspring Size Among Populations of Water Snakes **Patricia Covington**		90 How Students Have Learned to Love Histology - comparing WiFi vs regular compound light microscopes **Joni Criswell**	

3:15 PM		62- Bringing a historic collection into the modern era: Curating the J. K. Underwood seed collection at the University of Tennessee Herbarium (TENN) **Nathaniel Kingsley**, Chelsea Miller, Holly Brabazon, Ian Ware and Jessica Budke,	70 - Wild Hog (Sus scrofa) Preference Among Planted Pine and Hardwood Seedlings and the Ecological Factors Influencing Young Forest Plantation Damage **Micah Fern**, Rebecca Barlow, John Kush and Jim Armstrong				
3:30 PM			Break for Posters				

Lightning Talk Session
Exhibit Hall Southwest

4:15 PM	197 – Stop Teaching Mendel in Intro Genetics **Jennell Talley**
4:20 PM	198 – I am your father…or am I? Parentage analysis in amphipod Crustaceans. **Kristine N. White** and Sarah Cuccinello
4:25 PM	199 – Photogrammetric Determination of Canopy Convergence in a Bottomland Hardwood Forest **Melissa Bloch** and Joydeep Bhattacharjee
4:30 PM	200 – Hydrophobicity and self-cleaning properties of the brille of snakes **Susanna Walker** and Matthew Lehnert
4:35 PM	201 – Advances in Big Data and Digital Imagery Are Helping to Push Environmental Science Forward **Matthew Heard**
4:40 PM	202 – Horizontal Gene Transfer as a Mechanism for Convergent Evolution in Divergent Species **Jennifer Kovacs**, Ellen Martinson, Caitlin Conn and John Werren

Thursday Posters
Exhibit Hall Southwest

1 – Supplemental Instruction at Marshall University
Megan Haffner and Karen McComas

2 – BeATLe Book Groups and Three Books that Changed My Teaching
Darlene Panvini

3 – Applying QM Course Mapping to a Traditional General Microbiology Laboratory Course
Dr. Lisa Ann Blankinship

4 – Recruitment and success of majors using a data-driven approach to teaching introductory biology
Christopher Paradise and Malcolm Campbell

5 – STEM Mia - Integrated approach to enhancing minority student success
Loretta Ovueraye

6 – Developing Scaffolds to Support Undergraduate Students in Learning and Understanding Biological Concepts
Jaime Sabel

7 – USING POLYMER CLAYS TO MAKE MOLDS AND CASTS OF FOSSILS FOR TEACHING AND OUTREACH
Jeremy Bramblett, Timothy Gaudin, Andrew Heckert and Marta Toran

8 – Supporting Students in an Undergraduate Non-majors Biology Course to Develop Self-Efficacy and Metacognition
Katlyn Morris and Jaime Sabel

9 – The Young Dragons of Mendelia: an extensions of a synthetic genetics system as an outreach teaching system for Mendelian Genetics in middle and secondary schools.
Kaitlyn Monat and C. Brian Odom

10 – Boots on the ground: Experiential learning helps students think critically about their academic pathways
Stephanie Jeffries

11 – A Distributional and Taxonomic Study of Vicia (Fabaceae) in Alabama.
Michael Woods and Eric Minton

12 – The Genus Galactia (Fabaceae) in Alabama
Haley Odom and Michael Woods

13 – Taxonomic Study of the Clematis reticulata Walter Species Complex (Ranunculaceae: Subgenus Viorna A. Gray): A Multiple Evidence Approach
Thomas Murphy and Dwayne Estes

14 – Morphological variation within the Hawaiian endemic tree Planchonella sandwicensis
Elizabeth Dean, Ulf Swenson, Stephan Nylinder and J. Christopher Havran

15 – Arbuscular mycorrhizal fungi communities in soils at different contamination levels of lead (Pb)
Austin Gilly, Sigurdur Greipsson and Thomas McElroy

16 – Comparing ecophysiological traits between two populations of Micranthes petiolaris when grown in a common environment
Dakota Wagner, Laary Cushman and Alisa Hove

17 – Characterizing the Grease on Greasegrass (Tridens flavus L.)
Katie Horton, Tom Diggs and Clarke Miller

18 – Analysis of Volatile Organic Compounds of Calycanthus floridus and Calycanthus brockiana Using Combined Gas Chromatography and Mass Spectroscopy
Abigail English, Tom Diggs and Clarke Miller

19 – The Phytoremediative Effects of Coriandrum sativum in Lead Contaminated Soil
Sierra Garrett and Timothy Trott

20 – Adaxial and Abaxial Absorption of Light and the Influence on Gas Exchange in Holly
Kathyrn Young, Anthony Percival, Liliana Rangel-Parra and Howard Neufeld

21 – Is oak mistletoe host species distribution the result of the correlation between seasonal patterns of host tree growth and mistletoe phenology?
Christopher Randle, Tyler Bates, Kelsey Bond, Reagan King, Andrew Martinez, Nicholas Reger, Sana Sadiq, Ashlan Walker, David Warren and Donovan Haines

22 – Rapid Measurements of Gas Exchange in an Evergreen Angiosperm: Plant and Gas Exchange System Responses to Rapid Changes in Environmental Parameters
Liliana Rangel-Parra, Anthony Percival, Erica Pauer, Kathyrn Young, Fernando Alejo-Vann and Howard Neufeld

23 – Discovery and Restoration of a Forgotten Garden
Noel Cawley

24 – A flora of the vascular plants of Pine City Natural Area (Monroe Co., AR): the importance of a flora for conservation priorities
Diana Soteropoulos and Travis Marsico

25 – Soil crust algal communities of Warren Prairie Natural Area, Arkansas
Karen Fawley, Brent Baker and Marvin Fawley

26 – Checklist of the vascular flora, restoration plans, and educational interpretive signs for a remnant prairie at the Lakewood Memorial Cemetery, Hinds County, Mississippi
Olivia Shelton

27 – The Ronald L. Jones and Ralph L. Thompson Herbaria at Eastern Kentucky University
Nick Koenig, Calvin Andries, Thomas McFadden, Bailey King, Robert Pace and Brad Ruhfel

28 – Making a Large Impact on a Small Herbarium: The Impacts of an NSF CSBR Grant on a Regional Herbarium
John Schenk, Andrea Appleton, Colleen Evans and Maggie Kuhn

29 – Identification of moss species at Wingate University Campus Lake in Wingate, NC
Emily Barbee and Christy Carter

30 – Continued Efforts to Approximate the Flora of Tater Hill Plant Preserve
Danielle Privat, Matt C. Estep and Andrew P. Jenkins

31 – Preliminary analyses of the flora of Grandfather Mountain
Ethan Hughes

32 – The Growth and Digitization of the Campbell University Herbarium
Renazja Harris, Jordan Bergan, Kendra Jones, Bryce Sprinkle, Alexander Krings and J. Christopher Havran

33 – Using digitized herbarium specimens to predict the potential distributions of Tennessee's historical plant species
Erica Rylander and Joey Shaw

34 – An Overview of the Catawba College Herbarium (CATU) Located in the Central Piedmont of North Carolina
Jessica Willis, E. Malachi Gray, Jay Bolin and Michael Baranski

35 – Using Confocal Microscopy to Compare Arbuscular Mycorrhizal Fungi Associations in Two Riparian Species, Salix nigra Marshall and Platanus occidentalis L.
Taylor Swaggerty, Sarah Andrews, Lindsey Gard, Ludny Saintine, Ashley Turcios, Kalani White and Paula Jackson

36 – Fungal Microbiota Richness and Abundance Found in Conventional Versus Organic Farming Techniques
Katherine Morgan, Cynthia Ryder and Elizabeth Danks

37 – Potential Transmission of Snake Fungal Disease Through Wooden Box Traps in Biodiversity Study
Brandon Jack

38 – Role of Bacillus subtilis in Polyester Degradation
Micaela Robson and Stephanie Mathews

39 – Fomites in the Fitness Center: Fitness Equipment Harbors Antibiotic Resistant and Pathogenic Bacteria
Pierce Prevost and Dawn Simms

40 – Effect of cosmetic preservatives on the growth, biofilm formation, and the gene expression of Staphylococcus epidermidis1457
Audrie Campbell and Esther Choi

41 – Detection and Characterization of Biosurfactants Produced by Marine Bacteria
Keelie Butler, Chloe Baumgardner and Michelle Thomas

42 – Construction of high-copy hemC::lacZ and hemE::lacZ reporters to identify a heme-responsive transcriptional regulator.
Caitlyn McClain and James Smart

43 – The search for Vibrio cholerae genes involved in fatty acid-mediated biofilm formation
Isabel Gray and David Giles

44 – An Examination of Allee Effects in Vibrio cholerae
Eric Siv, Erick Rojas, Jin Wang, Bradley Harris and David Giles

45 – Biofilm formation and virulence factors of Candida albicans in JEG-3 cell line
Madison Studstill and Esther Choi

46 – Isolation and Identification of Bacteriophage from Commercially Available Bacillus thuringiensis
Kristina Jansen and Dinene Crater

47 – Efficacy Testing of Novel Anti-Biofilm Lead Compounds
Brian Tirado, David Goode and Linda Hensel

48 – Assessing the Production of DNase A by Biofilm-Producing Environmental Competitors Induced by an Extract of Pseudomonas aeruginosa Biofilm.
Kyra Watral

49 – Antibiotic resistance awareness among undergraduate students
Valentina Roa

50 – The Bactericidal Properties of Bis-substituted Triazolium Salts
Julie Wilson, Lauren King and Kerri Shelton

51 – Comparison of Bacterial species richness in Organic vs. Conventional Farms
Ashley Sherrard, Cynthia Ryder and Elizabeth Danks

52 – Scraping the Surface: The Isolation, Identification, and Analysis of Antibiotic Producing Bacteria from Williams Bayou, Palmetto, Florida
Julia Schran and Eric Warrick

53 – A Walk in the Park: The Isolation of Antibiotic Producing Pseudomonas
Morgan Dettmer and Eric Warrick

54 – Going to the Beach for A Solution : The Isolation and Extraction of Compound(s) from the Exiguobacterium species.
Magnolia Valdez and Eric Warrick

55 – Isolating Antibiotics from Marine Soil for the Tiny Earth Initiative
Oliva Short and Eric Warrick

56 – Antibiotics as Modern Biological Weapons: A biological arms race between bacterial resistance and discovery.
Aubrey Carey and Eric Warrick

57 – Characterizing gut microbiota in Plethodon cinereus, the Red-backed Salamander
N. Reed Alexander, Jessica A. Wooten and Donald M. Walker

58 – The Effect of Antimicrobial Peptide WAM-1 on Multi-drug Resistant Acinetobacter baumannii
Todd Wood and Lauren King

59 – Bacterial Communities in Salt Pans along the Mississippi Gulf Coast
Lauren Lawson, Eric Weingarten and Colin Jackson

60 – Potential Cutaneous Physicochemical Changes and their Effect on Antibiosis in a Salamander Microbiome
J. Trey King and Richard M. Austin, Jr.

61 – The effect of vulva wash on the growth of Lactobacillus acidophilus
Tahlaya Hudson and Jennifer Hancock

62 – Environmental and Life History Factors Influence Dragonfly Gut Microbiomes
Sarah Russell and Colin Jackson

63 – Attachment, invasion, and surface protein expression of Acinetobacter baumannii
Rachel Pearson and Lauren King

64 – Detection of Snake Fungal Disease Causing Fungus, Ophidiomyces ophiodiicola, on Free Ranging Snakes in Managed Habitats in Northwest Georgia
Jennifer Turner, Sara Grimm, Miranda Gulsby and Thomas McElroy

65 – Sediment Bacterial Communities of South Atlantic Tidal Wetlands Driven by Salinity
Kayla Clark, Eric Weingarten and Colin Jackson

66 – Rhus typhina and Rhus copallinum extracts exhibit antimicrobial activity toward ESKAPE pathogens
Kathleen Loughman and Joseph Horzempa

67 – The Therapeutic Phage Discovery Laboratory at Wingate University: A continuing undergraduate research program.
C. Brian Odom, Lauren Arrington, Olivia Brown, Samantha Hiller, Heather King, Shrevas Modi, Kaitlyn Monat, Meredith Saunders, Jonea Stewart and Christy Thompson

68 – Exploratory investigations via 16S rRNA and rDNA Illumina sequencing into microbial community composition across a salinity gradient in coastal South Carolina wetlands
William Conner, David Miller and Alex Chow

69 – The presence of Clostridium difficile spores in the environment of rooms in a Pediatric Intensive Care Unit
David Giles, Henry Spratt, David Levine, Mark Rowin, Rachel Keilman and Charles Woods

70 – Detection of Legionella Species in Various Potting Soils
Rayne Ragains

71 – Identification of gram-negative bacteria in expressed milk: effects of storage on reuse
Casidy Stoltz, Cynthia Ryder and Kathryn Gill

72 – Experimenting with Non-Genetically Modified Organisms In Cornflakes Cereals
Leon Orenstein, Omar Aboulhouda, Kimsovathany Bun, Alberto Espinoza, Andrew Vincent, Muna Zhou and Ernest Ricks, Jr.

73 – Analysis of novelty seeking, multiple drug usage, and the serotonin transporter gene in college students
Shivani Vasudev, Jennell Talley and Matthew Schmolesky

74 – Directed Evolution of cold active Beta-galactosidases from Geobacillus sterothermophilus
Cynthia Obilor

75 – Investigation of Genetic Modification in Labeled Non-GMO Soy-Based Baby Formulas
Ernest Ricks, Jr., Tina Alighanbari, Yodit Koya, Demarius Tookes, Suzana Batazhan, Jonathan Cross, David Brown, Neha Lalani, Abimbola Agbaje and Vaidehi Patel

76 – The Effect of Thymic Nurse Cells on the Reproductive System in Mice

77 – Determining the Nativity of a Typha latifolia Population in a Mountain Bog via Genetic Analysis
Ben Brewer, Michael Battrick and Matt Estep

78 – Testing Utility of Current Phylogenetic Markers in Genus Neohelix (Gastropoda: Polygyridae)
Amanda C. Wilkinson, R. Wayne Van Devender, Amy S. Van Devender and Matt C. Estep

79 – The development of microsatellite markers for the culturally and economically significant plant, Allium tricoccum
Morgan Gaglianese-Woody, Jennifer Rhode Ward and Matt C. Estep

80 – Comparative transcriptomics in higher order floral structures of Asteraceae
Carolina Siniscalchi, Ramhari Thapa and Jennifer Mandel

81 – Analyzing the Evolutionary Relationships of Rosa varieties by DNA Barcoding and RAPD
Jaydon Gibbs, Quinlan Harsch and Brittany Gasper

82 – Sequencing of the Fragmented Chloroplast and Mitochondrial Genomes of Pithophora sp. (Horsehair Algae)
Marcus J. Meade, Kalina Manoylov and Bruce Cahoon

83 – Chloroplast and Mitochondrial Genomes of a Pediastrum duplex Isolate from Central Georgia
Grayson Proulex, Kalina Manoylov and Bruce Cahoon

84 – Microsatellite Primer Development for the Federally Threatened Apios Priceana (Fabaceae)
Annie Lindsey, Joshua Kraft, Lydia Deason, Robert Howard and Carol Baskauf

85 – Algal Biodiversity Genetic Survey of the Middle Chattahoochee River
Amanda Hall, Kevin Burgess and John Hanson

86 – Exploring the Repetitive Fraction of Grass Genomes using Galaxy
Patrick French and Matt C. Estep

87 – Human Genealogy and Computer Science: Interdisciplinary project in Bioinformatics
George Beason, Benjie G. Blair and Monica Trifas

88 – Comparative Analysis of Four DNA Preparation Kits for Quercus falcata, Quercus palustris, Quercus rubra DNA Extractions and Subsequent DNA Sequencing
Devin Cummins and Timothy Trott

89 – Testing for reticulation events between three lineages of dusky salamanders in South Carolina
Jessica Trueblood, Haley Honeycutt and David Beamer

90 – Investigating the Presence of Genetically Modified Genes in Non-GMO Labeled Corn Chips
Ernest Ricks, Jr., Riley Wildeman, Hans Lee, Fergie Giron, Wendy Gomez, Mahnoor Maha, Amanda Bowers and Ashley Villamil

91 – Determining seed viability and fruit maturation differences in weedy and native radish, R. raphanistrum
Cassie Stark

92 – Comparing genetic diversity and resilience to human disturbance among Appalachian salamanders
Kaitlyn J. Loesel, Griffin D. Caracciolo, Jessica Smith, Daniel Whitson, Keelan Passmore, Andrew Duitsman, Julia M. Sandoval, Jessica A. Wooten, Carlos D. Camp and Emily Bewick

93 – Sexual selection and sexual-size dimorphism in lungless salamanders (Plethodontidae)
Tabea M. Soelter, Jessica A. Wooten and Carlos D. Camp

94 – Evidence of Horizontal Gene Transfer in the Kissing Bug Rhodnius Prolixus
Tierra Hammond, Caitlin Conn, Ellen Martinson, John Werren and Jennifer Kovacs

95 – Evidence of Horizontal Gene Transfer in the Pea Aphid Acyrthosiphon pisum
Denver Cooper, Ellen Martinson, Caitlin Conn, John Werren and Jennifer Kovacs

96 – New fossil material of the bowfin, Amia, from the Sentinel Butte Formation (Paleocene), Medora, North Dakota
Abby Grace Moore, Michael Newbrey, Hugo Martín-Abad, Clint Boyd, John Hoganson and Mark Bair

97 – Trees Infected with Mistletoe (Viscum album) in southwestern Arkansas
Jared Standley, Cora Engen and Kate Sheehan

98 – Quantification of intelligible influences on the growth and distribution of American ginseng: Habitat modeling and field studies
Jacob Peters and Heather Griscom

99 – A Preliminary Analysis of Floral Morphological Traits Within a Population of Hymenocallis coronaria (Shoals Spider-Lily)
Ashley Desensi

100 – Correlations Between Seasonal Precipitation and Bobcat (Lynx rufus), Desert Cottontail (Sylvilagus auduboni), and Black-tailed Jack Rabbit (Lepus californicus) Photo Rates Over 9 Years in Southcentral New Mexico.
Rebecca Bolich and Travis Perry

101 – A comparison of the enzyme profiles of two pitcher plant species (Sarracenia jonesii and Sarracenia purpurea var. montana) and their hybrids
Ashleigh Brandon, Caroline Kennedy, Rebecca Hale and Jennifer Rhode Ward

102 – Isotope Analysis of Breeding Tree Swallows (Tachycineta bicolor) in Western North Carolina
Zachary Lappie and Andrew Laughlin

103 – Quantifying Nectar Rewards of Bee-Preferred Wildflower Species Native to the Southern Appalachian Mountains
Christian Brown and Jennifer Geib

104 – Investigating Phenotypic Plasticity of Hydrocotyle bonariensis in Response to Soil Type and Salt Spray
Annelise Kim and Heather Joesting

105 – Anthocyanin profiles of Photinia glabra during leaf expansion, senescence, and infection by the pathogenic fungus, Entomosporium mespili
Harrison Seitz, Nicole Hughes and Sarah Jessica Forte

106 – Anthocyanins increase flower temperature: a study using a broad range of taxa and flower morphologies
Sarah Jessica Forte and Nicole Hughes

107 – Physiological responses to LPS: immunity vs dispersal in Florida cane toads
Steven Gardner, Kyra Smith, Vania Assis, Arthur Appel and Mary Mendonca

108 – Impacts of Polyploidy on the Ecophysiology of Solidago altissima
Katie Krogmeier and Howard Neufeld

109 – Histological analysis reveals background levels of intersex in Largemouth bass (Micropterus salmoides) of the Chattahoochee River and two tributaries, Columbus, GA
Meenal Joshi, Elizabeth Klar, Abigail Abernathy, Amy Sibley, Jeramy Belt and Michael Newbrey

110 – The Role of Leaf Angle and Its Influence on Potential Gas Exchange in an Evergreen Holly
Erica Pauer, Fernando Alejo-Vann, Kathyrn Young, Anthony Percival, Liliana Rangel-Parra, Courtney Watts and Howard Neufeld

111 – First Year Results on from Phenology Gardens and a Phenology Trail on the Campus of Appalachian State University
Morgan Ayers, Erica Pauer, Anthony Percival, Katie Krogmeier and Howard Neufeld

112 – Morphological responses to diet by the generalist grasshopper Melanoplus differentialis
Jerry Howard and Austin Culotta

113 – Winter Time Gas Exchange in an Evergreen Angiosperm: Intra-Canopy Differences and Responses to Light
Anthony Percival, Liliana Rangel-Parra, Erica Pauer, Kathyrn Young, Fernando Alejo-Vann, Courtney Watts and Howard Neufeld

114 – Occurrence of intersex in male Spotted bass, Micropterus punctulatus, Chattahoochee River, Columbus, Georgia
Cherish Jordan, Elizabeth Klar and Michael Newbrey

115 – Monitoring the Health of the Swan Lake Iris Gardens Ecosystem in Sumter, South Carolina
Pearl Fernandes and Daniel Kiernan

116 – Assessment of microbial respiration and carbon loss rates in the upper Ohio River and selected tributaries in the Northern Panhandle of West Virginia
Emma McClelland and James Wood

117 – Habitat utilization and impact of flooding on James spinymussel (Parvaspina collina)
Christine Verdream

118 – Investigating the Effect of Air Circulation in Plant Grow Beds on Arugula and Bibb Lettuce Productivity in a Freshwater Aquaponic System
Olivia Roddenberry and Heather Joesting

119 – The Distribution and Ecology of Freshwater Sponges in Western North Carolina
Allison Griggs, David Corcoran, Joel Smith, Christina Strobel, Taylor Strope and Cara Fiore

120 – A comparison of clearwater and blackwater streams in Fort Benning Military Installation, GA, using abiotic and biotic parameters.
Emma Davis, Mark Schimmer, Daniel Isenberg and Brian Helms

121 – Habitat Selection Across Temperature and Nutrient Gradients
Sarah McNamara and William Resetarits

122 – Structural and biological diversity in the Lee Branch stream on the Midway University Campus: an additional look
John Delfino and Guipsy Lopez

123 – Evaluating Stream Restoration Program Effectiveness Using Benthic Macroinvertebrates as a Proxy for Stream Health
Lucas Manweiler, Brian Anderson, Cameron Baker, Andrew Douglas, Haley Grove, Rhett McBrayer, Nicole McCroddan, Kathryn Motley, Andrea Navarro, Brittany Sweet and Bruce Wiggins

124 – Response of General Esterase and Glutathione-s-Transferase Enzymes to MCHM Exposure in the Fathead Minnow, Pimephales promelas
Erin Burke

125 – Assessment of a Thirteen-Year-Old CREP Restoration Project at Smith Creek, Rockingham County, Virginia
Jacob Peters, Morgan Hussey, Hannah Macmillan, Sara Schoen, Christine Verdream and Heather Griscom

126 – Competitive interactions between stream salamanders and crayfish in the southern Appalachian Mountains
Susan Cragg, Josh Ennen, Kristen Cecala, Jon Davenport and Shawna Mitchell

127 – Spatially Explicit Habitat Selection: Contagion and The Ideal Free Distribution
Reed Scott and William Resetarits

128 – Histopathological comparison of livers of Largemouth bass (Micropterus salmoides) from the Chattahoochee River and a tributary, Columbus, Georgia
Amy Sibley, Elizabeth Klar and Michael Newbrey

129 – Intensity of trematode infection and body size are positively correlated to nematode infection in Western Mosquitofish
Lindsay Higgins and Megan Gibbons

130 – Salinity Stress Response of Rock Crayfish (Cambarus carinirostris)
Addie Shanor, Zachary Loughman and James Wood

131 – A comparison of salamander communities in a managed section versus an impacted on-campus section of a Northwest Georgia first order stream
Kaytlin Pepper and Brittany Flood

132 – Does the quality of symbiosis between green alga (Oophilia amblystomatis) and spotted salamander (Ambystoma maculatum) embryos affect morphology and performance of larvae?
Caroline Kennedy, Mischa D'Errico and Rebecca Hale

133 – The effects of a stream restoration project on condition factor, growth, and diet of Bluegill Sunfish (Lepomis macrochirus)
Jake Hollows, Mason Ferrell and Tom Blanchard

134 – Assessing Water Chemistry Trends in the Upper Ohio River Watershed
Haley Miller, Emma McClelland, Emily Huff and James Wood

135 – An ecological assessment of the four major streams in West Virginia's Northern Panhandle
Garrett W. Hoover and James Wood

136 – Accidental biocontrol agent or just another invader?
Sara Osorio and Loretta Battaglia

137 – Chronological age and the prevalence of intersex within Largemouth bass (Micropterus salmoides), lower Chattahoochee River near Columbus, Georgia
Jeramy Belt, Elizabeth Klar, Abigail Abernathy, Meenal Joshi and Michael Newbrey

138 – Comparison of benthic macroinvertebrate assemblages in a mitigated urban stream and a control stream in Chattanooga, Tennessee
Hannah Wilson and Mark Schorr

139 – Long-Term Carbon Retention of Restored Sandy-Bottom Streams at Fort Benning Military Installation
Lauren Conklin, Alexis Rogers, Daniel Isenberg and Brian Helms

140 – Analysis of tree mortality in carbon offset plantings in central NC
Kylie Roehrle and David Vandermast

141 – Evaluation of secondary successional changes in Elon University Forest after the ice storm of March 2014
Madeline Turnau and David Vandermast

142 – Response of Restoration Chestnut Seedlings to Forest Management Strategies
Zoe Bergman, Cassie Stark and Heather Griscom

143 – Precipitation Event Size Controls on Autotrophic and Heterotrophic Respiration in a Desert Grassland
Zoe Bergman

144 – Habitat Interactions of Wet Pine Savanna
Henry Woolley and Jerome Howard

145 – Pu'uwa'awa'a: Restoring a Tropical Dry Forest on the Big Island of Hawai'i
James R. Giddens, Elliot W. Parsons and J. Christopher Havran

146 – The Effects of Prescribed Burning on Herpetofaunal Communities in the Shoal Creek District of the Talladega National Forest
Garrett Hood and George Cline

147 – The Effects of Kudzu (Pueraria montana var. lobato) on plant community diversity
Gina Profetto

148 – Potential Effects of Declining Coarse Woody Debris on East Coast US Forests
Corinna Steinrueck

149 – Microtopographic control of cliff-face vegetational communities in the Amphibolite Mountain Macrosite
Georgia Harrison and Mike Madritch

150 – E. coli in Wheeling Creek
Emily Huff and James Wood

151 – Above and below ground impacts of Solenopsis invicta
Victoria Spencer, Erika Young, Kaitlin Campbell, Lisa Kelly and Conner Sandefur

152 – Avian species assemblages within Bursera simaruba live fences in Panama: 15 years of secondary succession
Morgan Hussey, Christopher Will and Heather Griscom

153 – Urbanization & Bird Biodiversity in the Southeastern United States over a 10 Year Period
Jasmine Gaillard, Ebony Gaillard and Jennifer Kovacs

154 – soil chelating agents used in lead (Pb) phytoextraction by switchgrass.
Nick Sbravati

155 – A Method for Quantifying Herbivory Using Open-Source Programming
Emily Poindexter, Shawn Krosnick, Christopher Murray and Samuel Wehunt

156 – Assessing patterns of plant richness and terrestrial productivity in Great Smoky Mountains National Park using data from the National Ecological Observatory Network (NEON)
Diane Styers and Jennifer Schafer

157 – Phenology, Pollination, and Seed Dispersal Syndromes in Reforested Dry Tropical Ecosystems
Christopher Coggin and Heather Griscom

158 – An Assessment of Compositional Shifts in Mississippi Forests: Two Centuries of Change in the Woody Taxa Comprising Forests of Forrest County, MS
Donaven McLaurin

159 – Leaf spectra as indicators of Beech Bark Disease
Patrick Latimer and Mike Madritch

160 – Detection and Identification of Arbuscular Mycorrhizal Fungi in Two Riparian Tree Species Using AML1 and AML2 PCR Primers
Sarah Andrews, Taylor Swaggerty, Kalani White, Ashley Turcios, Ludny Saintine, Lindsey Gard, Joel McNeal, Thomas McElroy and Paula Jackson

161 – Foliar Salicylic Acid Application improves phytoextraction of Switchgrass Grown in Lead Contaminated Soil
Summer Johnson and Abdullah Saad

162 – Phytoextraction of Lead Contaminated Soil via Switchgrass Enhanced by Foliar Iron Application
Katherine Doussa and Sigurdur Greipsson

163 – The confluence of disjunct plant species in a remarkable Eastern Highland Rim seepage grassland, Putnam County, Tennessee
Claire Ciafre and Dwayne Estes

164 – Using remote cameras to assess the diversity of avian frugivores that use oak mistletoe (Phoradendron leucarpum) in forested wetlands of southeastern Virginia and northeastern North Carolina
Nicholas Flanders and Eric Walters

165 – Bird Diversity and Abundance in Urban Greenways
Kelley Coleman and Andrew Laughlin

166 – Effects of Fire Severity and Urbanization on Plant Communities in the Great Smoky Mountain National Park
Mali Hubert and Monica Papeş

167 – Small mammal and invertebrate diversity on a suburban campus: A comparison of four microhabitats
Makayla Ferrari, Liam Lorenz, Morgan Greenway and Christopher Brown

168 – Some like it cold: snow algae are major drivers of archaeal, bacterial, and fungal communities in snow
Avery Tucker and Shawn Brown

169 – Chlamydomonas reinhardtii mutant cc6-1, is cytochrome c biogenesis deficient
Kyra Anderson, Sara Cline, Patrice Hamel and Max Sgro

170 – How Cellular Metabolic State and the Chaperone Protein Hsp104 Interact to Affect the Spontaneous Formation of the Yeast Prion [URE3]
Demyia Graham, Ross Whitwam, Barsha Subba and Katie Brinkman,

171 – The Effects of Lipopolysaccharide and Peptidoglycan on Progesterone Receptor Expression in HeLa Cells:
Christopher Brandon and Aubree Cox

173 – Differential Roles of EDNRB Isoforms in Breast Cancer Cell Lines
Zuhaila Hired, Grace Rutledge, Katherine Iglesias and Rebecca Conway

174 – Novel Compound Pyridazine's viability as an Epinephrine Alternative
John Wilson, Ashley Williams, Shainaz Landge and Vinoth Sittaramane

175 – Pyridazine Compounds as Novel Anti-Cancer Therapeutics
Favour Ukpongson

176 – Restrictive PCR and Sequence Analysis Suggest Circularization of mRNAs in Human HEK Cell Line Mitochondria
Landon Mance, Steven M. Shell and Bruce Cahoon

177 – Identifying Markers of the Hybrid Epithelial/Mesenchymal State
Charles Perry and Amy Abell

178 – The epithelial stem cell phenotype is controlled by the expression and activity of NF-κB family members
Noha Shendy and Amy Abell

179 – Modulation of Phagocytic Activity of Alpha-Synuclein Stimulated Microglial cells by Anti-inflammatory agents
Kyra Brewer, Robert Haining and Cindy Achat-Mendes

180 – Optimization of western blotting for the detection of proteins of different molecular mass
Diptika Raut, Sagarina Thapa and Ghanshyam Heda

181 – The Effects of Calcitriol and Seocalcitol on c-Myc, n-Myc, Id2 and p53 in SK-N-SH Neuroblastoma Cells
Natalie Lenard and Katelyn Ohmer

Friday, April 5, 2019 AM

	Symposium: Evolutionary Patterns of Biodiversity BR B	Plant Systematics BR C	Herpetology A BR D	Cell and Molecular Biology BR E	Community Ecology C Mtg Rm 201/202	Aquatic Ecology Mtg Rm 203/204	Conservation Mtg Rm 205
8:00 AM	95 – Phylogeny and Evolution of Asteraceae using Hyb-Seq Data **Jennifer Mandel**	103 – The phylogeography of the southeastern species of the genus Dalea L. (Fabaceae) using a phylogenetic approach **Joshua Fuller**, Desiny Moore and Tom Diggs	111 – Breeding Success in Xenopus laevis raised in laboratory at Jacksonville State University (JSU) **James Rayburn**	119 – Pancreatic beta cell dysfunction in response to chronic hyperglycemia is partially mediated by transcriptional downregulation of Gli-similar 3 (Glis3) **Erin Clayton**	127 – A Comparison of Bee Communities and Floral Resources in Agricultural Fields and Surrounding Natural Areas in Southern Illinois **Leila Kassim**, Casey Bryan, Karla Gage and Sedonia Sipes	135 – Translating museum archive science to studies of free-ranging wildlife: clinical assessment of bone density in the common bottlenose dolphin, Tursiops truncatus **James Powell** and Deborah Duffield	143 – Identifying Habitat Utilization and Movement of a Federally Endangered Narrow Endemic Crayfish Species, Cambarus veteranus (Guyandotte River crayfish) via Radio Telemetry **Nicole Sadecky** and Zachary Loughman
8:15 AM	96 – Wildfire impacts on below ground microbial communities are strongly dependent on soil layer, location, and burn severity: toward a framework of ecosystem recovery **Shawn Brown**, Allison Veach, Jonathan Horton, Ari Jumpponen and Richard Baird	104 – High-throughput flow cytometry and DNA sequencing identifies over 20 potential new species of Isoetes (Isoetaceae, Lycopodiophyta) in the southeastern US **Peter Schafran**, Jay Bolin, Carl Taylor, Elizabeth Zimmer and Lytton Musselman	112 – Hypotheses of Assemblage Organization in Appalachian Dusky Salamanders: A Critical Re-examination **Carlos Camp**	120 – Regulation of Cell Fate Decisions in Mus Musculus Preimplantation Blastocysts **Deepthi Raghu** and Amy Abell	128 – Oviposition Site Choice and Larval Development of Odonates (Anisoptera) in Response to a Predatory Fish **Kevin Potts** and William Resetarits	136 – Estimating taxonomic diversity using growth profiles and stinger morphology of 34 million year old stingrays from North Dakota **Persia Tillman**, Michael Newbrey, Clint Boyd and Todd Cook	144 – Rangewide conservation assessment and analysis of land use impact on Cambarus spicatus (Broad River Spiny Crayfish) **Riley Aulick**, Bronwyn Williams, Emmy Delekta, T.R. Russ, Greg Myers and Zachary Loughman

8:30 AM	97 – Southeastern Islands and Biogeography **Chris Havran**	105 – The systematic value of pollen morphology in Chresta Vell. ex DC. (Vernonieae, Asteraceae) **Carolina Siniscalchi**, Benoit Loeuille, Raquel M.B. Souza-Souza, José Rubens Pirani and Vania Gonçalves-Esteves	113 – Upland Snake Community in Restored Montane Longleaf Pine Habitats in Paulding and Sheffield Wildlife Management Areas **Miranda Gulsby**	121 – Conserved Mechanism of Eukaryotic Histone-Induced Cytochrome C release **Vanessa Chappell**	129 – Anchialine lakes of the Bahamas support unusually dense populations of Acetabularia spp. and other Dasyclade algae. **Scott A. Woolbright**, Heath M. Birchfield, Dawn M. Ford, Kate L. Sheehan, Matt P. Ashworth, Rachel A. Yeager, Christopher H. Martin, Schonna R. Manning, Rene A. Shroat-Lewis and Laura S. Ruhl	137 – Investigating the physicochemical niche of macrophyte Podostemum ceratophyllum Michx. (Hornleaf riverweed) **Samuel Canfield** and James Wood	145 – Distribution and Genetic Diversity of Nabalus serpentarius and its Common Congener, N. trifoliolatus (Asteraceae) **Steven Ballou**, Paige Murin and Jennifer Mandel
8:45 AM	98 – Phylogenomics Reveals New Insights into the Adaptive Radiation of Beetles on Plants **Duane McKenna**	106 – Species Dispersal Modes in Amphitropical Plant Species of North and South America **Samera Mulatu** and John Schenk	114 – Prey Selection in the Queen snake, Regina septemvittata, in Streams of the Northern Panhandle of West Virginia, U.S.A. **Dan Meyer**, Elijah Henderson and Zachary Loughman	122 – Neprilysin: A Possible Regulator of PI3K Signaling in Triple Negative Breast Cancers **Katherine Iglesias**, Zuhaila Hired, Grace Rutledge, Khadija Kirmani, Jazmine Stubblefield and Rebecca Conway	130 – Do Fiddler Crabs Influence Plant Growth and Soil Chemistry? Getting to the Bottom of the Burrow in Gulf Coast Tidal Marshes **Gwendolyn Murphy** and Loretta Battaglia	138 – Defining broad scale habitat associates for an imperiled crayfish, Cambarus veteranus **Eric Tidmore** and Zachary Loughman	146 – Genetic Structure as a Response to Anthropogenic and Extreme Weather Disturbances of a Coastal Dune Dwelling Spider, Arctosa sanctaerosae **Robert A Hataway** and David H Reed
9:00 AM	Break for Posters	Break for Posters	Break for Posters	Break for Posters	Break for Posters	Break for Posters	Break for Posters
10:30 AM	99 – Phylogeography of the American Black Bear (Ursus americanus) **Emily Puckett**	107 – Staminode Evolution in Mentzelia Section Bartonia (Loasaceae) and their Impact on Insect Visitation Rates **John Schenk** and Lucia Botnaru	115 – Inter- and intra-population variation in spatial ecology of Eastern Box Turtles (Terrapene carolina) in fire-maintained and unburned forests **Dr. John Roe**	165 – A determination of berberine concentrations in commercially available Hydrastis canadensis herbal supplements using HPLC. **Claire Brewer** and Timothy Trott Break for Posters	131 – Effects of environmental conditions on survival of a bird-dispersed mistletoe, Phoradendron leucarpum **Nicholas Flanders**, Christopher Randle and Eric Walters	139 – Examining the presence and abundance of microplastics in the Cumberland River in Nashville, TN. **Lina Said** and Matthew Heard	147 – Cryptic Hybridization in Southern Appalachian Pitcher Plants (Sarracenia spp.) **Jennifer Rhode Ward**, Rebecca Hale and Caroline Kennedy

10:45 AM	100 – The Evolution and Development of Staminodes in Paronychia **Andrea Appleton** and John Schenk	108 – Phylogeny, Character Evolution, and Biogeography of Antennaria (Gnaphalieae, Asteraceae) Inferred from Hundreds of Loci **Ramhari Thapa**, Randall Bayer and Jennifer Mandel	116 – Herpetological assemblages in reforested tropical dry forests of the Azuero Peninsula, Panama **Tyler Kovacs** and Heather Griscom	123 – Stability of CFTR on plasma membrane of a lung epithelial cell line. **Sagarina Thapa** and Ghanshyam Heda	132 – The role of continuous flowering phenology in neotropical plant-pollinator interactions across an elevation gradient **Chelsea Hinton** and Valerie Peters	140 – Assessing fish movements in a culvert-bisected stream reach using instream stationary antennas **Will Commins** and Bill Ensign	148 – The Tennessee Plant Conservation Alliance: Preventing the local extinction of Tennessee's rare plants through collaborative partnership **Cooper Breeden**
11:00 AM	101 – The evolutionary consequences of heritable microbes that manipulate animal reproduction. **James E Russell**	109 – A rangewide herbarium-derived dataset indicates high levels of gene flow in black cherry (Prunus serotina) **James Beck**, Lauren Konrade and Joey Shaw	117 – The Influence of Exotic Plant Leaf Litter on Amphibian Growth and Development **Spencer Cruz**	124 – Investigating the Assembly Pathway for the Yeast Mitoribosomal Small Subunit **Tania Perez**, Samuel Del'Olio and Dr. Antoni Barrientos	133 – The effect of nutrient growth media on microbial diversity cultured from Desmognathus fuscus skin **Tori Hongo**, Samantha Chu and John Niedzwiecki	141 – Ecological Impacts of a Recetly Dammed River in the Indian Himalayas **Alex Fields** and Joydeep Bhattacharjee	149 – Induction of caulogenesis in a critically endangered African violet (S. rupicola B.L. Burtt) for production of new plants **T. Warner Lowry**
11:15 AM	102 – Evolution and Affect: The Detection of an Emotional Response to Evolution **Mark Bland**	110 – Dichanthelium (Poaceae) of Arkansas: from 16 to 46 species **Justin Thomas**	118 – The Phenology of the Symbiotic Association Between Ambystoma Maculatum and Oophila Amblystomatis Using Molecular Techniques **Griffin McDaniels**, Chris Murdock, George Cline and James Rayburn	125 – Regulation of Drosophila nociception by RNA-binding proteins **Andrew Bellemer**	134 – Testing for trade-offs in varying plant defense strategies **Nicole Soper Gorden**, Peter Maddaus, Gina McClanahan, Coral Foster and Andrew Disco	142 – The Effects of Local Riparian Zone and Streambed Sediment on the Abundance, Diversity and Distribution of Freshwater Fishes in Piedmont Streams of South Carolina **Scott Finney**, Dennis Haney and Greg Lewis	150 – In Situ conservation physiology of the rare white fringeless orchid **Savanna Wooten**
11:30 AM	Lunch	Lunch	Lunch	126 – Development of microsatellite markers to investigate recurrent polyploidy within the genus Dicentra. **Jessie Hatcher**, Lindsay Shields and Matt C. Estep	Lunch	Lunch	151 – Longleaf Pine seedling survival rate in response to environmental factors **David McCollum**

Friday, April 5, 2019 PM

	Evolution BR B	Plant Systematics/Physiology BR C	Herpetology B BR D	Invertebrate Biology B BR E	Population Ecology Mtg Rm 201/202	Aquatic Ecology Mtg Rm 203/204
1:15 PM	152 – Climatic change and parental care in wild birds **E. Keith Bowers**, Alexander Mueller and Kelly Miller	160 – The status of violet (Violaceae) taxonomy in the southeastern U.S. flora **Harvey Ballard**	168 – Ecosystem functional consequences of predator density as mediated by maternal diversity **David Smith** and Cy Mott	175 – Life History of an Imperiled Appalachian Crayfish Species, Cambarus callainus (Big Sandy Crayfish) **Christopher Vopal** and Zachary Loughman	181 – Effect of Climate and Individual Characteristics on Seed Production and Morphology of Red Maple (Acer rubrum) in the Central Appalachian Region. **Abby Goszka** and Rebecca Snell	189 – Investigating Populations of Brook Trout (Salvelinus fontinalis) Above and Below Waterfalls in Virginia **Hannah Macmillan**
1:30 PM	153 – Variation in Eggshell Coloration in Eastern Bluebirds (Sialia sialis) **Rin Pell**, Annabelle McKie-Voerste and Thomas Risch	161 – Morphological challenges in identification of taxa in the Rhododendron viscosum group (Ericaceae). **Charles Horn**	169 – Home Range and Habitat Use of the Eastern Box Turtle (Terrapene carolina) in the North Georgia Piedmont **Amber Rittgers** and Samantha Shea	176 – Intraspecific variation in the symbiotic protozoan Hyalophysa (Ciliophora, Apostomatida). **Randall Bassham** and Stephen Landers	182 – Integration of genetic structure and demographic data in the endangered Pyne's ground plum (Astragalus bibullatus; Fabaceae) **Ashley B. Morris**, Kevin Trostel, Cassandra Scalf, Austin Burleyson, Geoff Call and Matthew Albrecht	190 – Conservation and Distribution of Creaserinus fodiens (Digger Crayfish) in Pennsylvania **Tanya Khan**, David Lieb and Zachary Loughman
1:45 PM	154 – Ontogenetic variation of nodosaurid armored dinosaurs (Nodosauridae, Ankylosauria) with description of a new juvenile specimen from the Lower Campanian Mooreville Chalk of Alabama **Michael Burns** and Jun Ebersole	162 – Taxonomy of the Clematis viorna complex (Clematis subgenus viorna) of the southeastern United States. **Zach Irick** and Dwayne Estes	170 – Relationships between artificial wetland creation on former surface mines and pond-breeding amphibians in the Cumberland Mountains, USA **Walter Smith**, Kyle Hill, Dakota Taylor, Katy Mullins and Lindsey Harper	177 – Wetting dichotomy in the feeding mechanism of Diptera and the convergent evolution of fluid feeding insects **Ellen Camerato** and Matthew Lehnert	183 – Copperhead Foraging Ecology at a Recreational Site in the Daniel Boone National Forest **Jesse Sockman**, Josh Hendricks, Austin Owens, Kyle Muennich and Stephen C. Richter	191 – Effects of sub-lethal levels of antibiotics on the growth of freshwater algae. **Asia Gladney** and Matthew Heard
2:00 PM	155 – Differential Gene Expression as a Tool for Assessing Homology among Extrafloral Nectaries in Passiflora L. (Passifloraceae) **Silas Maynord** and Shawn Krosnick	163 – A New Rush Species Endemic to the Altamaha Grit of Georgia **Richard Carter** and Wesley Knapp	171 – An eDNA approach to surveying Necturus in Central and Northern Alabama waterways. **Katelyn McDaniels**, Chris Murdock and George Cline	178 – Polyparasitism in the blood of the Tufted Titmouse (Baeolophus bicolor) and Northern Cardinal (Cardinalis cardinalis) **Kayla Fast**	184 – Phytochemicals and genotype choice by insects in an old field plant species: a growing consensus and future questions addressing cytotype effects **Ray Williams**	192 – Urban Stream Restoration: Conveyance and Material Processing Channels **Madeline Berg**

2:15 PM	Short Break	Short Break	Short Break	Short Break	Short Break	Short Break
2:45 PM	157 – Bacterial Relics from the Pangaea Super-continent? **Eric Becraft**, Maggie Lau, El-Kebir Mohammed, Joe Brown, Julie Brown, Jessica Labonte, Duane Moser, Joshua Sackett, Brittany Kruger, Esta van Heerden, Alzbutas Gediminas, Victor Kadnikov, Nikolai Ravin, Tullis Onstott and Ramunas Stepanauskas	164 – Phylogeography and population genetics of Sandmyrtle (Kalmia buxifolia, Ericaceae) **Emily Gillespie**, Tesa Madsen-McQueen and Zack Murrell	172 – The influence of salamanders on leaf litter decomposition in Appalachian headwater streams **Emily Jones**, J. Alex Baecher, Myesha James, Amy Braccia and Stephen C. Richter	179 – A new mode of insect respiration: Enhanced oxygen delivery to the lepidopteran proboscis **Matthew Lehnert**, Miao Jiang, Qi-Huo Wei, Valerie Kramer and Kristen Reiter	185 – Demographic and spatial analysis of Blackwater Ecologic Preserve (Isle of Wight, Co., VA) provides insight into the origin of longleaf pine (Pinus palustris) stands **Peter Schafran**, Nicholas Flanders, Toni Dotterer, Isaiah Amos and Lytton Musselman	193 – Ecosystem functional consequences of top predator amphibian mortality due to the invasive shrub, Lonicera maackii **Josey Berta** and Cy Mott
3:00 PM	158 – Does asexuality confer a short-term evolutionary advantage? The case of the widespread apomictic fern Myriopteris gracilis (Pteridaceae). **James Beck**, David Wickell and Michael Windham	166 – Variation in monoterpene emissions across potential hosts and over time as an explanation of local host preference in Phorandendron leucarpum (Raf.) Reveal & M.C. Johnst. (Viscaceae) **Andrew Martinez**, Nicholas Reger, Donovan Haines and Christopher Randle	173 – Texture in Arboreal Lizard Habitat Use **Travis Hagey**, John Philips and Eben Gering	180 – Capillarity in c-shaped conduits: Fluid rise in split proboscises of Lepidoptera without action of the sucking pump **Daytona Hedrick**, Matthew Lehnert, Jianing Wu and Ashley Lash	186 – Bombus sylvicola and Bombus balteatus genetic differentitation across the Central Rocky Mountains. **Isabel Sullivan**	194 – Short term effects of polystyrene on Aiptasia pallida **Natasha Sawickij**
3:15 PM	159 – A game theory approach to understanding the evolution of cooperative behavior **James E Russell** and Xin Xu	167 – RADseq techniques can be applied to DNAs derived from herbarium specimens **James Beck**, Ingrid Jordon-Thaden, Catherine Rushworth, Michael Windham, Nicolas Diaz, Jason Cantley, Chris Martine and Carl Rothfels	174 – Molecular phylogenetics and population genomics of map turtles (Genus Graptemys) **Jarrett Johnson**, Anthony Barley and Robert Thomson	197 – **Smooth-tipped proboscises of Lepidoptera are adapted for feeding from floral tubes Rena Fonseca**	187 – Is there sexual dimorphism in Spicebush (Lindera benzoin) prior to fruit production? **Martin Cipollini**, Natalie Bailey, Mary Grace Gaskin, John Patten Moss, William Walker and Shadae Williams	195 – Investigating the Physiological Effects of Varying Salinities on Adult Grass Shrimp, Palaemonetes pugio **Kaytlin Pepper**
3:30 PM	Break for Posters - 3:45 PM	Break for Posters - 3:45 PM	Break for Posters - 3:45 PM	Break for Posters - 3:45 PM	188 – Intraspecific Morphological Variation in Chamaecrista fasciculata from the Deep South is maintained in a Common Garden **Lisa Wallace** and Mahboubeh Hosseinalizadehnobarinezhad	196 – Biogeographic analysis of bacteria in the Sargasso Sea using high-throughput sequencing methods **John Geoffrey Gill**, Kristina Hill-Spanik, Kerry Whittaker and Craig Plante

	Lightning Talk Session Exhibit Hall Southwest
4:15 PM	204 – Increased alpha diversity, but decreased beta diversity, in avian communities following Eastern Hemlock decline **Andrew Laughlin**, Douglas Black and Kristin Anderson
4:20 PM	207 – Impacts of climate change on the distribution of breeding bird populations in Great Smoky Mountains National Park **Kristin Anderson**, Douglas Black and Andrew Laughlin
4:25 PM	300 – Identifying Roadkill Hotspots Using a Running Average **Kori Ogletree** and Al Mead
4:30 PM	205 – Sporophyll Anatomy Differences Among Four Isoetes Species **Lauren Zeh Heyd**, Lytton John Musselman and Peter Schafran
4:35 PM	208 – The Dragons of Mendelia: A synthetic genetic system for teaching transmission genetics. **C. Brian Odom** and Kaitlyn Monat
4:40 PM	209 – Adding to our knowledge of molecular phylogenetic relationships of the Rock-Boring sea urchin, Echinometra lucunter **Stanton Belford**
4:45 PM	203 – Coefficients of conservatism in Arkansas: Validation, changes in understanding of geographic regions after a floristic survey, and an exploration of ecoregion bias **Diana Soteropoulos**
4:50 PM	206 – Grasslandia: a journey to a different time and place **Dwayne Estes**, Theo Witsell, Alan Weakley and Reed Noss

Friday, April 5, 2019 | PM β β β

	BBB District 2 talks **Heritage III**	**BBB District 1 talks** **Magnolia BR**
1:15 PM	BBB Oral 8 – Stressor Interactions of Acid and Radiation in Native and Invasive Lonicera **Alexander Wharton** and Darlene Panvini	BBB Oral 1 – Synergistic Antibiotic Treatments in Acinetobacter baumannii **Ashley Murphy** and Lauren King
1:30 PM	BBB Oral 9 – The Use of Green Roofs by Avian Species and Their Preference in Green Roof Characteristics **Paige Ulrich** and Darlene Panvini	BBB Oral 2 – Optimizing Primary Microglia Isolation and Culture **Deanna Doughty**
1:45 PM	BBB Oral 10 – Growth of Andropogon gerardii (Big Bluestem) with 10-10-10 Fertilizer **Daniel Campos** and Darlene Panvini	BBB Oral 3 – Production and characterization of a microglial NF-κB deficient animal model **Michael Goodall** and Jennifer Bradford

2:00 PM	BBB Oral 11 – The Effects of Native and Non-Native Plant Species on CO2 Soil Flux Levels in Relation to Bacterial Community Diversity **Samantha Rodriguez**, George Bukenya and Darlene Panvini	BBB Oral 4 – Investigation of the toxicological effects of CNT-Ab in mice following microwave hyperthermia. **Andrew Mixson**, Moses Kusi, Amy Chall, John Stagg, Wilmot Gissendanner, Austin Rawlings, Mernyse Bruce, Worlanyo Gato, Rafael Quirino and Vinoth Sittaramane
2:15 PM	BBB Oral 12 – Varying 10-10-10 Fertilizer Concentration for the Optimal Growth of Kentucky Fescue (Lolium arundinaceum) **Nicholas Alexander** and Darlene Panvini	BBB Oral 5 – Herbicide toxicity to nontarget aquatic organisms does not increase in mixtures with surfactants **Courtney Telfort**
2:30 PM	BBB Oral 13 – Conversion of Glycerol to Butanol Using a Continuous Culture of Clostridium pasteurianum **Jonathan Kilroy** and Carmen Scholz	BBB Oral 6 – Predicting Colony Recognition in Argentine Ants, Linepithema humile **Katherine Barrs**, Hua Wang and Joshua Gibson
2:45 PM	BBB Oral 14 – Variation in the pulmonary circulation of Necturus salamanders (Urodela: Proteidae) **Alexandra Templin** and Michael Burns	BBB Oral 7 – Investigating the Effectiveness of the Antioxidant Catechin Hydrate on Artemisinin Activity in vitro **Wyatt Zander**, Carmony Hartwig, Carmony Hartwig and Carmony Hartwig
3:00 PM	BBB Oral 15 – First Evidence of Striped Bass Natural Reproduction in the Tennessee River. **Karen Inouye** and Anthony Overton	
3:15 PM	BBB Oral 16 – Treatment of Fungi with Photosensitizers and UVA **Ashley Wentworth** and Joseph Mester	
3:30 PM	BBB Oral 17 – Distance and timing of separation between first-order relatives in the raccoon (Procyon lotor) **Jillian Sturtevant**, Noah White, Evelyn Chukwurah, John Hisey and Michael Kennedy	
3:45 PM	BBB Oral 18 – The Impact of Heavy Metal Pollution from Small-Scale Golding Mining on Microbial Communities **Stephen Won** and Kevin Drace	

Friday Posters
Exhibit Hall Southwest

182 – Quantifying Behaviors in Zebrafish Autism Models
Celine Rey and Julia Dallman

183 – Syntomeida epilais (Lepidoptera: Erebidae) Male Modulation Cycle: Normal or Inverted, Does it Matter?
Yosmely Reyna

184 – Determining the effects of urbanization on the song of a vocal mimic, the gray catbird (Dumetella carolinensis)
Morgan Hussey, Jennifer To, Christopher Will and Dana Moseley

185 – Does the A-Call of a Chinese Blue-breasted Quail chick (Coturnix chinensis) change as it physically matures?
Lauren Pharr

186 – Effects of Sublethal Imidacloprid on Acheta domesticus Neuron Firing Activity and Chirping Behavior
Jenna Joyner, David Coffey, Jennifer Mozolic and Langdon Martin

187 – The mechanism and consequence of differences in morphology between two egg mass morphs in spotted salamander (Ambystoma maculatum)
Mischa D'Errico, Rebecca Hale and Caroline Kennedy

188 – Does The Low Chip Call of the Chinese Blue-breasted Quail Chick (Coturnix chinensis) Qualify as a Low Amplitude Contact Signal?
Edward Mills

189 – Is breeding-status dependent neural differentiation in Damaraland mole-rats context-dependent?
Sara Carter

190 – Possible Prey Switching Event in Puma concolor in Southcentral, New Mexico
Brandon Holsten and Travis Perry

191 – Black Bear (Ursus americanus) Response to Rising Annual Temperatures in Sierra County, New Mexico
Elena Smart and Travis Perry

192 – Tail flicking in birds; could this behavior help in a noisy world?
Natasha Vanderhoff

193 – Differential Predator Avoidance in Southern Two-Lined Salamanders (Eurycea cirrigera)
Mackenzie D. Devine, Emmeline W. Lombard and Carlos D. Camp

194 – Olfactory fear learning alters spatiotemporal coding of olfactory stimuli
Jordan Ross and Max Fletcher

195 – Investigating the Influence of Small-Scale Light Pollution on Bat Activity
Anton Mejias, Mason Carlisle and Michael Bender

196 – Mechanosensory sensitivity of naïve hawkmoths
Benjamin Allen and Joaquin Goyret

197 – Consistency of Personality Traits in Meadow Voles, Microtus pennsylvanicus
Karl Rohrer

198 – Parental Investment in Relation to Mate Quality: An Experimental Test
Kelly Miller, E. Keith Bowers and LeighAnn Poole

199 – Differences in the number of birds flushed in response to calls given by bird eating and non-bird eating hawks at a feeding station in northwest Tennessee
Randy Z. Gillespie III and H. Dawn Wilkins

200 – The effects of ambient noise and variation within vocalizations on avian behavioral response
Jacob Gerber

201 – Antlion Species Diversity in Gwinnett County Using Morphological Features and Principal Component Analysis with a Genetic Analysis of the CO1 Gene
Madelyn Yaceczko and Kassiel Serrano Rocha

202 – Characterization of the wetting properties for antion (Myrmeleontidae: Neuroptera) mouthparts and its role in the feeding process
Jordan Minninger and Matthew Lehnert

203 – Investigating the cause of success or failure of honey bee hives near Davidson, NC
Grace Covelli, Malcolm Campbell and Christopher Paradise

204 – Staining experiments with Synophrya, a parasitic ciliate found within the gills of portunid crabs
Tiffany Taylor and Stephen Landers

205 – Containment of a Cryptosporidium serpentis outbreak in a snake collection - A case study
Sarah Johanson, Kinsey Guthrie and Zachary Loughman

206 – Ants (Hymenoptera: Formicidae) of Mississippi
JoVonn Hill, Joe MacGown and Richard Brown

207 – Decomposition of Cattle Dung by Aphodius pseudolividus in Virginia is Density Independent
Kaitlyn Harless and Patrice Ludwig

208 – Identifying Digenetic Trematodes Infecting Elimia virginica snails and Cyprinid fish in Eastern Virginia
Anna Ruuskanen and Abbie Tomba

209 – Effects of ant chemical secretions on deterring myrmecochore seed mortality agents
Jamie L. Albert, Chloe L. Lash, Kimberly D. Gwinn and Charles Kwit

210 – Staining experiments with the ciliated protozoan known to cause shrimp black gill disease in Litopenaeus setiferus
Meet Patel and Stephen Landers

211 – Application of the electroretinogram (ERG) to assessing the visual system of fruit fly Drosophila melanogaster eye-shape mutants
Shuaitong Chen, Emily Daniels and Barry Rhoades

212 – Insect emergence from a disturbed headwater stream in Southern Appalachia
Cody Beavers and Amy Braccia

213 – Grain Properties and Selection of Pogonomyrmex rugosus Mounds
Moriah Van Voorhis

214 – Systematic Studies of the Cambarus longirostris (Longnose Crayfish) Complex
Danny Jones, Patrick Allison Jr., Riley Aulick, Nicole Sadecky, Eric Tidmore, Christopher Vopal and Zachary Loughman

215 – Individual-level foraging niche variation in the omnivorous Eastern Box Turtle, Terrapene carolina
Jasmine Kelly and John Roe

216 – Effects of Wildfire and Timber Harvest on Terrestrial Salamander Populations in the Southern Appalachians
Nicholas DelPaoli, Grant Connette and Michael Osbourn

217 – Examining the contact zone between northern and southern two-lined salamanders (Eurycea): Has hybridization occurred?
Alexis Wiggins, Samantha Gaskins, Tyquan Smith and David Beamer

218 – When, how, and why do snakes move? A case study validating internal implantation of accelerometer data loggers to remotely and continuously monitor movement behavior of wild snakes
Miranda Gaupp, Dominic DeSantis, Amy Wagler, Vicente Mata-Silva and Jerry Johnson

219 – Importance of fire and water chemistry in explaining twenty years of change in amphibian communities of the Francis Marion National Forest
Nicole Strauss and Daniel McGlinn

220 – Mate-guarding and pair-bonding behavior in green salamanders, Aneides aeneus
Paul Cupp

221 – Habitat Characteristics of the Rare Patch-nosed Salamander (Urspelerpes brucei)
Tyler L. Brock and Carlos D. Camp

222 – Initial assessment of Terrapene carolina status and trends in North Carolina using 10 years of data from the Box Turtle Connection
Dr. John Roe, Ann Somers and Gabrielle Graeter

223 – Preliminary Study of Culturable Bacteria from the Mouths of Individuals from the Family Natricinae in Northern Alabama
Dawn Canterbury, Sandra Elliott, Griffin McDaniels and Katelyn McDaniels

224 – Cryopreservation and hormonal induction of spermic urine in a novel species: the smooth-sided toad (Rhaebo guttatus)
J. Alex Baecher, Kristin Hinkson and Sinlan Poo

225 – Color cues: Does body coloration signal quality in male green frogs?
Jorden Christensen and Barry Stephenson

226 – Utilization of Frog Calls and Visual Cues to Survey the Frogs of the Jacksonville University Campus
Nathan Ikeda and John Enz

227 – Using trail cameras to monitor seasonal migrations of two pond-breeding salamander species
Elijah Thompson, Kenzi Stemp, Tom Anderson, Brittany Ousterhout, Jacob Burkhart, Haley Towne, Katherine Sutcliffe and Jon Davenport

228 – An Examination of Arboreal Habitat Selection by the Green Salamander (Aneides aeneus)
Faith Jackson, Burley Ball, McKayla Grasham, Richard Turner and Walter Smith

229 – The relationship between zooplankton assemblages and predatory salamanders in ponds of the central Ozarks, Missouri
David Burton, Thomas Anderson, Brittany Ousterhout, Jacob Burkhart and Jon Davenport

230 – Searching for salamanders: confirming the presence of two uncommon species on Northern Shenandoah mountain
Jack Doss

231 – Conservation and Management of Eastern Hellbenders (Cryptobranchus alleganiensis) in West Virginia
Ruth Freemon, Joe Greathouse and Zachary Loughman

232 – Genealogical history and admixture proportion of tiger salamanders in Black Lake, Mono County, California.
Ivy Irihamye and Jarrett Johnson

233 – Identifying Cryptic Lineages within the Northern Dusky Salamander Species Complex Using mtDNA
Kathryn Davis, Nicole Laura, James Davis and David Beamer

234 – Phylogeographic Analysis of Seepage Salamanders (Desmognathus aeneus)
Henri Vega-Bernal and David Beamer

235 – Meta-Analysis of Eastern Indigo Snake Research Over the Last 10 Years
Zachary Starr and George Cline

236 – Hybridization between Anuran Hylids in Northeastern Alabama
Andrew Collins and George Cline

237 – Impact of Feeding Frequency on Juvenile Growth
Colleen Hoselton, Kinsey Guthrie and Zachary Loughman

238 – Ecology of Nerodia sipeodon (Common Watersnake) in North Fork Creek, Ohio County, West Virginia.
Elijah Henderson, Dan Meyer and Zachary Loughman

239 – Effects of Water-Related Abiotic Factors on Stream Salamander Abundance
Alanna Horton, Christopher Paradise and Bradley Johnson

240 – Impact of Long-Term Terrestrial Salamander Mark-Recapture
Natalie Depalma, Kathryn Steffen, Nicholas DelPaoli, Grant Connette and Michael Osbourn

241 – The presence of Cry1aB in infant snacks

242 – Detecting the Presence of cry1aB in infant snacks
Jasmine Holligan, Levi Tran, Rosa Reyes, Elizabeth Hernandez and Ernest Ricks

243 – Comparing extranuclear localizations of histone H3 in two human cancer cell lines
Parker R. Byrd, Claudia L. Rocha, John W. DeStefano, John P. Kinson, Nicolas W. Shugarts and Mary Katherine Zanin

244 – Cannabidiol (CBD) does not protect against an in-vitro model of hypoxia in rat neuronal cells.
Jake Dunn and Michael Grider

245 – Microglial mediated anti-inflammatory properties of nicotine on dopaminergic neurons
Hannah Staley, Robert Haining and Cindy Achat-Mendes

246 – Transformation of Marine Dinoflagellates to Shed Light on Bioluminescence
Lila Barrera, Mookho Paw, Ni Eban, Mark Venable and Cara Fiore

247 – Cost Effective Strategies for Supplementing Cell Culture Media in an Undergraduate Teaching Laboratory
Josue Fuentes, Elisabeth Javazon and Shoshana Katzman

248 – Evaluating candidate genes involved in extrafloral nectary development in Passiflora with in situ hybridization
Shawn Krosnick, Lillian Cordell, Mikayla Mangrum and William Willborn

249 – The effects of chemical and biological gold nanoparticles on human dermal fibroblasts
Samantha Courtney, Sai Lata De, Pavan Rajanahalli and Sneha Krishnamurthy

250 – Conservation of Histone H3 Binding to Mitochondria Across Eukaryotes
Shelby Harris, Samia Meera, Dianna Thompson, Vanessa Chappell and Roger Sauterer

251 – Adhesive Organs in Turbellaria: Result from Freshwater Species
Charles Wolfe and Julian Smith, III

252 – Nicotine effects on human cardiac microvascular endothelial cell viability
Raven Gahn and Natalie Lenard

253 – Utilizing HPLC to Determining Levels of Short Chain Fatty Acids (SCFAs) in Shigella flexneri 2a Strain (ATCC 29903) Grown In-Vitro.
Jeremy Paradice, Jessica Wade and Kingsley Dunkley

254 – Evaluating Glucose Consumption and ATP Yield for Shigella flexneri grown in LB broth
Jessica Wade, Jeremy Paradice and Kingsley Dunkley

255 – The Effect of Receptor for Advanced Glycation End Products on Cancer Metastasis
Yelitzza Aguilar, Barry Hudson and Melinda Magna

256 – Utilization of Immunoassay and SDS-PAGE to Analyze Myosin-Light-Chain in Predominant Meat Species in Southeastern USA
David Howell and Kingsley Dunkley

257 – An examination of the microbiome of bat feces from a White Nose Syndrome positive site.
Georgia Caso, James Smart and Nancy Buschhaus

258 – A quantitative analysis of Pseudogymnoascus destructans in bat feces from a White Nose Syndrome positive site
Kellas Ujcich, James Smart and Nancy Buschhaus

259 – Thermal Range Specialization in Tropical Bees: Implications for Climate Change
Kristin Conrad and Valerie Peters

260 – The effect of a thermal gradient on age and growth characteristics of Largemouth Bass (Micropterus salmoides)
Mary Halbrook, Michael Newbrey, William Gunter, Raymond Beamesderfer and John North

261 – Using physiological conditions to assess patterns of Subarctic wood frog (Rana sylvatica) habitat suitability
Thomas Hastings, LeeAnn Fishback and Jon Davenport

262 – Germination of camphor seeds dispersed by American Robins
Natasha Vanderhoff

263 – Effects of ecological light pollution on insect communities
Nicholas DiMassimo and Christopher Paradise

264 – Succession on Black Belt Prairies by Eastern Redcedar Trees
John Barone and JoVonn Hill

265 – Floristic indicators of wind, logging, and fire in longleaf pine woodlands
Jonathan Kleinman and Justin Hart

266 – Drivers of endophyte communities of the invasive plant Kudzu (Pueraria montana var. lobata) in the Southeast United States: toward a framework of integrative plant management
Maryam Shahrtash and Shawn Brown

267 – Distribution, abundance, and fruit production of Nandina domestica, a toxic invasive species
Zoe Nuhfer and James Ferrari

268 – Herbaceous layer diversity declines as Microstegium vimineum invades an old growth forest in Eastern Kentucky
Kevin Faccenda and Jennifer Koslow

269 – Characterizing the microbiome of honey
Kai Brady, Dene Voisin, Erica Harris and Jennifer Kovacs

270 – Avian communities of the tropical dry forests of the Azuero Peninsula, Panama: a comparative study of reforestation type
Tyler Kovacs and Heather Griscom

271 – Analyzing community structure and composition of woody vegetation between riverine landforms in channelized and unchannelized sites
Katriana Maslin, Lisa Krueger and Paula Gale

272 – Effects of Habitat Fragmentation on Biodiversity of Mammals and Arthropods on Metro-Atlanta College Campus
Rose Rychlicki, Christopher Brown and Dominique Levy

273 – Effects of Solidago altissima cytotype and soil nutrients on terpene production, leaf nutrients and Uroleucon nigrotuberculatum abundance
Beck Akhiwu and Ray Williams

274 – Pollinator Nest Webs: Elucidating the succession of species associated with below ground bumblebee nests
Jacqueline Staab and Jennifer Geib

275 – Variation in bat species diversity and activity at the Beech Ridge unit of the Obion River Wildlife Management Area
Aubree Weitzel, Jeremy Dennison and Nancy Buschhaus

276 – Effect of artificial light on nocturnal activity of medium-sized mammals on a suburban college campus
Johnathan Taylor-Anderson and Christopher Brown

277 – Influence of Environmental Plastics on Freshwater Macroinvertebrate Distribution in Colombia County, Arkansas
Emily Phillips, Allysia Hurt, Katrina Hall and Kate Sheehan

278 – Splitting up a complex mess: Sharpening the tools when the old ones don't cut it
Sara Schoen and David McLeod

279 – Aquatic Macroinvertebrates as Bioindicators of River Health
Elizabeth Fain

280 – Assessing hunting pressures and the population status of Preuss's red colobus, Piliocolobus preussi, in Cross River National Park, Nigeria
Ruth Bowers-Sword, Joshua Linder and Roshna Wunderlich

281 – The Distribution of Microplastic Pollution in Aquatic Systems of Columbia County, Arkansas
Allysia Hurt, Emily Phillips, Katrina Hall and Kate Sheehan

282 – Macro-invertebrates as Bio-indicators of the Eno River.
Jazlyn Pointer

283 – Estimating Mammalian Activity Patterns in Old Growth with Camera Traps
Sarah Sheehan and Luke Dodd

284 – Pine rockland grass seed germination response to smoke water seed pretreatments
Lisa Krueger and Kenley Schwartz

285 – Siren intermedia Colonization of a Recently Constructed Wetland
C. Kabryn Mattison, Kenzi Stemp and Jon Davenport

286 – Modeling the Effects of Foliage Management on Floral Abundance and Bombus impatiens Population Dynamics
William Vannoy

287 – Prevalence of Plastic Debris in the Digestive Tract of Cattle
Paige Lawson and Kate Sheehan

288 – Scent Lures; Do They Work for Small Mammal Sampling?
Maggie Woodall, Jancy Burge and Michael Bender

289 – Investigating seasonal and annual patterns in water quality in a freshwater aquaponics system
Courtney Gest and Heather Joesting

290 – Testing Island Biogeography Theory using small mammals on islands in Lake Lanier
Alex Ceren, Mary Redmond and Michael Bender

291 – Microfiber Prevalence and Abundance in Freshwater Fishes from Lake Columbia, AR
Wesley Franklin and Kate Sheehan

292 – Analysis of Morphological and Genotypic Variation Among Populations of Lactuca hirsuta var. sanguinea
Paige Murin, Steven Ballou and Jennifer Mandel

293 – A Comparative Survey of the Morphology of Faxonius sp. Crayfish at Streams in Giles County, Tennessee
Samantha Davenport, Madison Yurewitch and Stanton Belford

294 – Monitoring bat activity as white-nose syndrome becomes established in the North Carolina Piedmont region
Teresa Porter

295 – Off-road vehicle use as a growing source of wetland disturbance in central Appalachia, USA
Walter Smith

296 – The Effects of Wetlands and Forest Opening Size on the Richness and Abundance of Early-Successional Birds
Isabel Hildesheim, David Brown and Kaitlyn Kelly

297 – Estimating Black Bear Occupancy at Jellico Mountain Using Baited Camera Traps
Gage Shepard

298 – The Utilization Of Citizen Science As A Means To Monitor Invasive Species Populations In Ohio
Rebecca Ohm, Kevin Ruegg and Gregory Smith

299 – Invertebrate pollinator use of suburban greenspaces in Whitfield County, Dalton, Georgia
Brittany Jensen, Jared Burns and David DesRochers

300 – An Evaluation of Reforestation Pathways on Insect Richness in the Tropical Dry Forests of Panama
Melissa Encinias, Jack Doss, Idelle Cooper and Heather Griscom

301 – Can you trust the results of your automated bat call classifier?
Sara Robertson

302 – Assessing Geographic Patterns of Genetic Variation and Gene Flow in North Carolina Populations of the Gopher Frog (Rana capito)
Nathaniel Akers and Brian Arbogast

303 – Use of elkwallow habitats by waterfowl in southwest Virginia, USA
Kyle Hill and Walter Smith

304 – Investigations into the reproductive biology of the Southern Appalachian endemic Piratebush (Buckleya distichophylla): Pollination biology, fruit development, and seed germination
Conley K. McMullen, Ryan Huish, Amy E. Faivre and Melissa Manow

305 – Genetic Sex Ratio Analysis of the American Pika (Ochotona princeps) in the Rocky Mountain Region
James Kitchens, Liesl Erb, Chris Ray and Alisa Hove

306 – Data added to remote camera surveys by video footage
Savannah League, Travis Perry and Nokubonga Mgqatsa

307 – Population Dynamics and Unique Foraging Ecology of Copperheads in the Red River Gorge, KY.
Josh Hendricks, Jesse Sockman, Austin Owens, Kyle Muennich and Stephen C. Richter

308 – A Reassessment of the Crayfishes of Pennsylvania's Lake Erie Basin with an Emphasis on Zoogeography, Taxonomy, and Conservation
Patrick Allison Jr., Tanya Khan, David Lieb and Zachary Loughman

309 – Using Flow Cytometry to Determine the Reproductive Cycle in Mice
Sarah Pippin and Oliver Oakley

310 – Histological techniques reveal differences in intersex occurrence and severity in Largemouth bass (Micropterus salmoides) and Spotted bass (Micropterus punctulatus)
Abigail Abernathy, Elizabeth Klar, Cherish Jordan, Meenal Joshi and Michael Newbrey

311 – Does Fitness Level Change the Dive Reflex Response?
Laurin Jones and Joni Criswell

312 – Tensile Strength Comparison of Long Muscle/Short Tendon Units to Short Muscle/Long Tendon Units
Sara Glendinning, Kasey Grant and Anna Lee Travis

313 – Differential Effects of Non-Associative and Associative Learning on Neuronal Activity in Mouse Gustatory Cortex.
Stephanie Staszko, John Boughter and Max Fletcher

314 – Response to Vibrational Stimuli in Cottus carolinae and Carassius auratus
Jennifer Kolwicz

315 – The effect of cannabidiol and lamotrigine on action potentials in earthworms ventral giant fibers and sciatic nerves in frogs and mice.
Zachary James, Hsien-Hui Chu and Donald Shaw

316 – Cannabis-Induced Neuroplasticity in the Dopaminergic Reward System
Brandon Stewart

317 – Therapeutic hypothermia for the preservation of residual hearing following cochlear implant surgery
Nina Latorre

318 – Stress and College Students: The Impact of Nature and Tree Climbing
Sophie Willihnganz

319 – Centrum morphology, age, and growth of Cretalamna sp. (Lamniformes, Otodontidae), a shark, from the Cretaceous Mooreville Chalk Formation (Santonian to Campanian), Alabama
Caroline Murphy, Michael Newbrey, Mikael Siversson and Dana Ehret

320 – Larval zebrafish as an in vivo model to study gut motility disorders
Tierney Daw and Mary Kinkel

321 – Preliminary comparison of effects of Apple Snail Extract to Xenopus laevis and Ambistoma maclatum
Andrew Shirley, Johnny Ubi and James Rayburn

322 – A Preliminary comparison of the developmental effects of Pomacea maculate egg extracts to embryos of Xenopus laevis.
Johnny Ubi, Andrew Shirley and James Rayburn

323 – Studying the effect of chromosomal content on posterior progenitor cells in zebrafish embryos
Elsie Rodriguez and Cortney Bouldin

Friday βββ Posters
Exhibit Hall Southwest

BBB 1 – Structure-to-Function Relationships of Metal Substitution in Lipoxygenase Activity
Claire Fabian-Bayola, Oluwatosin Ayinde and Adam Offenbacher

BBB 2 – A survey of aquatic macro- and micro-invertebrates of vernal granite outcrop pools in North Georgia
Joshua Fuller, Cruz Mejia-Rodriguez, Ana Guimaraes-Ferreira and Margi Flood

BBB 3 – University of North Georgia Herbarium Project
Samantha Shea, Hannah Umstead and Amber Rittgers

BBB 4 – Cigarette Smoke Exposure Upregulation of Phospholipase A_2 Metabolic Pathway Expression in the Bladder as a Promotor of Tumorigenesis.
Jessica Nix and Shannon Kispert

BBB 5 – A two-year study monitoring macroinvertebrate assemblages and leaf litter breakdown rates to assess the impact of Dalton State College campus on College Creek
Cody Beavers, Michael Cuprowski and John Lugthart

BBB 6 – Phytoremediation of Arsenic (III) Oxide and Sodium Arsenate with Vetiveria Zizanioides
Bryan Lopez, Karla Gomez, Jose Acevedo, Hussein Mohamed and Hussein Mohamed

BBB 7 – Using cytochrome c oxidase I gene sequencing to identify acorn weevils in north central Alabama
Andres Leon, Malia Fincher and Johnson David A.

BBB 8 – The Effect of Micro-RNA 200a Targeting PTEN to Inhibit Apoptosis in THP-1 Cells Following a Lipopolysaccharide-Induced Immune Response
Mary Oliver and Melissa Scheiber

BBB 9 – Effects of testosterone propionate on embryonic zebrafish spine development
Sage Wyatt and Melissa Scheiber

BBB 10 – Examining the role of Levonorgestrel on the Invasive Behaviour of Human T47D Breast Cancer Cells in a Danio rerio Model
Ascharya Balaji and Melissa Scheiber

BBB 11 – Proteome Fishing: A Reverse Docking Study
Meredyth Kinsella

BBB 12 – Food for the Future: A Study of Insects as a Protein Source for Global Food Security
Sharee Riggs

BBB 13 – PCR Detection of Bacterial Contamination in Gastrostomy Foods for Tube Feeding in a U.S. Hospital Setting
Lasata Shrestha, Nisha Bista, D. L. Milton, Teresa Johnson, Kelly Johnson, Holly Carter, Amy Spurlock and Joong-Wook Park

BBB 14 – Preliminary Investigations of Refuges as a Method to Capture Riverine Crayfish
Tien Anh Quach, Allison Moore, Emma Davis, Tanner Temple and Jonathan Miller

BBB 15 – Explanation of single nucleotide polymorphisms within human MET oncogene microRNA-binding sites
Emily Andersen, Holly Clifton, Caitlyn Sebastian, Ashesh Sharma, Jiansheng Wang, Brittany Rogers, Andrea Nichols, Mollie Rugg, Lasata Shrestha, Shelby Smith, June Wolford, Brooke Andrews, Nicole Tyler, Yakendra Bajgain, Alexander Kofman and Jill Zhong

BBB 16 – Software package for SNPs-microRNAs analysis
S. Andy, B. Angajala, A. Bontha, N. Dey, A. Harshakumar, H. Lad, Y. Patel, V. Puppala, N. Purushkumar, J. Yang, P. Yemineni, F. Zheng, Alexander Kofman and Jill Zhong

BBB 17 – The Sucking Louse Fauna of Mongolian Rodents: Host Associations, Molecular Phylogenetics and Description of a New Species
Chase Robinson, Lance Durden and Stephen Greiman

BBB 18 – Stream Macroinvertebrate Comparisons with New Technologies for Body Size Determination
Rachel Prokopius, Abby Nienaber and Richard Durtsche

BBB 19 – Determination of Madtom Shelter Preference
Mariah Slaughter

BBB 20 – Exploratory movements of leopard geckos in visual and non-visual environments.
Rob Tracey

BBB 21 – Effect of steroid hormone treatment on the viability of a glial cell line
Jesse Hunt, Tracee Guthrie, Candice Tate and Kathleen Hughes

BBB 22 – Presence of Dirofilaria immitis in Carolina dogs and mosquitoes in Southeastern Georgia
Angelica Tumminello, William Irby and William Irby

BBB 23 – Microscopic and molecular characterization of a novel planarian in sulfur spring (Blount Springs, Blount County, AL)
Rachel Harvey, Glenna Bridges and David A. Johnson

BBB 24 – The Evaluation of Reg1A as Potential Biomarker to Differentiate Inflammatory Bowel Disease
Lydia Rubenic and Amanda Williams

BBB 25 – Identification of Glomus (Glomeromycota) mycorrhizae in association with the aquatic plant Isoetes (Isoetaceae)
Kory Ly, Luke Humble, Viridiana Mandujano, Karina Noyola-Alonso, Angelo Troia and Jay Bolin

BBB 26 – Using Flow Cytometry to Study Polyploidy in Quillworts (Isoetes) an Enigmatic Lycophyte Lineage
Luke Humble, Kory Ly, Karina Noyola-Alonso, Viridiana Mandujano, Peter Schafran, Carmony Hartwig, Slavko Komarnytsky and Jay Bolin

BBB 27 – Antipredatory Behavior of Elimia paupercula, Sooty elimia, in response to Faxionous yahanlidus, the Spinywrist crayfish
Jessica Lenz

BBB 28 – Canada Geese (Branta canadensis) as Mechanical Vectors of Parasitic Protozoa
Liberty Sheppard, George Argyros, George Argyros and George Argyros

BBB 29 – Potential antimicrobial activity of plant species in the genus Plantago
McKenna Hunt, Jason Jones and Dr. Lisa Ann Blankinship

BBB 30 – Prevalence of Healed Long-Bone Fractures in Arboreal and Flying Squirrels
Carley Gunnell and George Argyros

BBB 31 – Disinfestation Methods for Tissue Culture of Sequoia sempervirens
Andrea O'Malley and Janice Haldeman

BBB 32 – Prevalence of Antibiotic Resistance in the Gut Flora (Enterobacteriaceae) of Wild and Domesticated Horses
Madison McKinsey, George Argyros, George Argyros and George Argyros

BBB 33 – Removal of Heavy Metals from Polluted Water
Caleigh Eberhardt, Bal Khatiwada and Bal Khatiwada

BBB 34 – Susceptibility of Microorganisms to *Rhus michauxii* Extract
Francisco Garcia, Benjamin Gahagen and Kingsley Dunkley

BBB 35 – Effect of Microhabitat Variation on Spring Ephemeral Plant Diversity
Collin Durant, Aliya Donnell-Davenport, Aliya Donnell-Davenport and Aliya Donnell-Davenport

BBB 36 – The Effects of Urbanization on the Biological Integrity of Georgia Streams
Schuyler Gentry

BBB 37 – Chemoreception in the fall armyworm, Spodoptera frugiperda: New strategies for management
Michele Moncrief, Corey Brooke, Leah Pool, Hannah Rose, Jordan Sparks, Joanna Gress, Joanna Gress, Joanna Gress and Joanna Gress

BBB 38 – Effects of Tetracycline Exposure on Rotifer (Philodina acuticornis) Egg Production in the Parental and F1 Generation
AnnaTaylor Hydrick and Naoma Nelsen

BBB 39 – Does Stream Health Affect Parasites Load in Lepomis Species?
Jonathan Carpenter and Aliya Donnell-Davenport

BBB 40 – A survey of madtom catfish population density at sites with differing mussel shell density
Cole Clark and Philip Lienesch

BBB 41 – Sampling the 'Wild': Isolation of Yeast Strains from Rowan County, North Carolina
Kara Cline, Carmony Hartwig and Carmony Hartwig

BBB 42 – Effects of Tricaine and Propofol on Sensory Function in Elasmobranchs
Molly Lanier

BBB 43 – Effect of abiotic factors on the condensed tannin concentration in Chamaecrista fasciculata
Andrew Disco, Nicole Soper Gorden, Nicole Soper Gorden and Nicole Soper Gorden

Field Trips

Saturday 8:00 AM - 3:00 PM Meet in the Sheraton Lobby	Sponsored by the University of Tennessee at Martin, Department of Biological Sciences and the Reelfoot Lake Environmental Field Station	**Wolf River Canoe Tour** Enjoy a scenic natural history canoe trip on one of the few remaining unchannelized rivers in West Tennessee with ecologists from UT Martin. This six mile section of the Wolf River winds through the Lost Swamp Trail which features habitats characteristic of the West Tennessee Mississippi River Flood Plain including old growth cypress forest, flooded bottomland hardwood forest, and open areas of spatterdock. Along some stretches canoes must go single file and make sharp turns around trees. We will leave from the conference hotel at 8am and return at approximately 3pm (roughly 4 hrs. on the river). Canoes are provided, but please bring water and lunch/snacks with you on this field trip. Transportation by carpooling/caravanning.
Saturday 9:00 AM - 1:00 PM Meet in the Sheraton Lobby	Sponsored by the Southern Appalachian Botanical Society	**Old Growth Forest and Spring Flora in Overton Park** Southern Appalachian Botanical Society Field Trip trip to see the early spring flora and old growth trees in Overton Park State Natural Area located in Memphis. Trip will include lunch provided by SABS. Carpool to the site from the Convention Center. Transportation by carpooling/caravanning.

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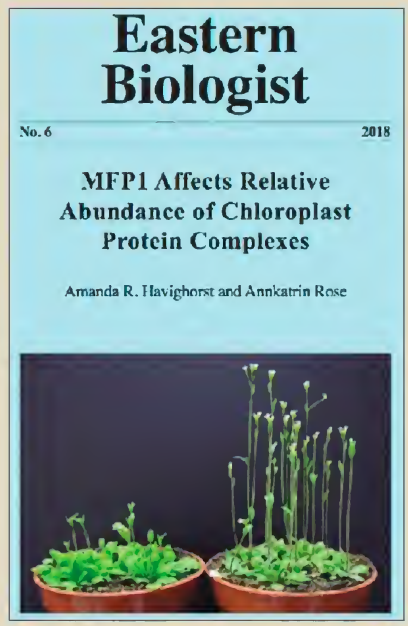

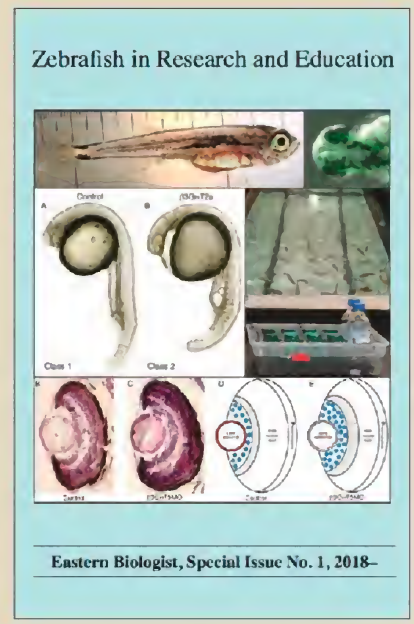

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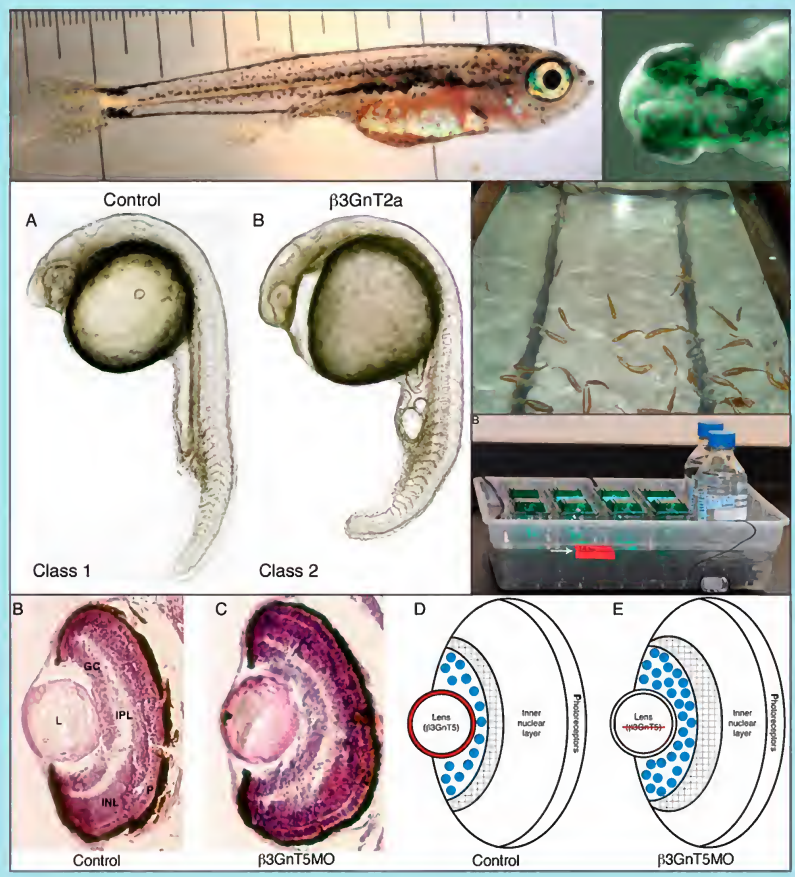

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Augmented Reinforcing and Anxiolytic Effects of Nicotine and Ethanol in Zebrafish
Michelle Hall-Kim, Maria Granada, Sarah Fuller, Elizabeth Dyle, and Cindy Achat-Mendes and Cindy Achat-Mendes

Analysis of Genetic Interactions and Developmental Requirements of the β1,3-N-acetylglucosaminyltransferase Family During Zebrafish Development
Quentin J. Machingo, Anandita Seth, Mary Adely, Lauren Wagner, Andreas Fritz, and Barry D. Shur

Larval Rearing Methods for Small-scale Production of Healthy Zebrafish
Alena Norton, Kitt F. Franse, Tierney Daw, Latanya Gordon, Peter F. Vitiello, and Mary D. Kinkel

Articles to be published...

Zebrafish Embryos and Bioinformatics: Useful and Marketable Exercises for Students Enrolled in Upper-Level Undergraduate Courses
Adam Davis, Hong Nguyen, and Jo Qian

Danio rerio (Zebrafish) Larvae Swimming and Escape Impaired by Fluoxetine
Lauren W. Stranahan and Linda M. Niedziela

4-Methylcyclohexanemethanol (4-MCHM) influences zebrafish (Danio rerio) larval behavior and plankton community composition
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Combining Technologies to Bring Efficient Zebrafish Mutagenesis to the Masses with CRISPR/Cas9
Megan D. Tennant, Ted Zerucha and Cortney M. Bouldin

Accumulating Evidence Of Danio rerio's Response To Biogenic Amines
Aleya Prasad, Allison McCoy, Jaime Wesley, Cade Thorton, and Lori McGrew

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